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DIFFERENTIAL RESPONSES OF [illegible] [illegible]

OF [illegible] [illegible] [illegible]

by

© LEONARD WALDEMAR [illegible]

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE

OF DOCTOR OF PHILOSOPHY

DEPARTMENT OF ZOOLOGY

EDMONTON, ALBERTA

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DIFFERENTIAL RESPONSES OF CAPTIVE COYOTES TO VARIOUS CANID SCENTS

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled "Differential Responses of Captive Coyotes to Various Canid Scents", submitted by Leonard Waldemar Mottus in partial fulfilment of the requirements for the degree of Doctor of Philosophy.

ABSTRACT

The responses exhibited by 9 coyotes, *Canis latrans* (Say), to various canid scents were studied in controlled laboratory conditions over a 13 month period involving 2994 experiments. The test odors used were urine and feces from coyotes and domestic dogs (*C. familiaris*) of various age, sex, social status and reproductive condition.

The coyotes responded differentially to canid odors, with the type, and frequency of response being closely associated with the reproductive cycle of both sexes. A changing motivation in the animals, and a changing odor of eliminations may be involved.

Urine and fecal odors appear to differ somewhat in the "messages" they convey, although both appear to contain information on sex, social status and breeding condition. The odor of urine has been interpreted as being "interesting", while fecal odors may be "threatening".

Captive coyotes scent mark with urine and feces. Urine marking is the most frequent, and may function for "self-reassurance" in response to a "threatening" odor. Feces marking may be the most important in terms of significance to other animals.

There appeared to be a cyclicity in scent marking that was in phase with the reproductive cycle, with a peak in marking frequency during the breeding period (late February) and a low in mid-November. Only adult males marked during this study, with dominant males marking more frequently than subordinate males.

Body rubbing was interpreted as being "self-marking", not as scent marking per se. Novelty and/or oddity of "interesting" odors may

motivate rubbing.

The problem of individual recognition by odors was discussed. It was suggested that in the conditions of the experiment, coyotes do not exhibit a recognition response to their own elimination. The concept of a "type" response to a "type" odor was presented.

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INTRODUCTION

Olfactory communication through scent marking is generally accepted as a social phenomenon of mammals (Ewer, 1968; Ralls, 1971). It has been described in a variety of species, ranging through orders such as Marsupialia (Ewer, 1968; Kean, 1967), Rodentia (Krames, Carr, and Bergman, 1969; Ropartz, 1968; Wynne-Edwards, 1962), Artiodactyla (Müller-Schwarze, 1969; Neal, 1959; Ralls, 1971), and Primates (Ewer, 1968; Jolly, 1966). In the Carnivora, it has been described in the Felidae (De Leeuw, 1957; Schenkel, 1966), Mustelidae (Eibl-Eibesfeldt, 1950; Lockie, 1966), Procyonidae (Kaufmann, 1962), Ursidae (Meyer-Holzapfel, 1957), Viverridae (Ewer, 1968; Zannier, 1965), and Canidae (Kleiman, 1966; Mech, 1970; Scott and Fuller, 1965). However, information about the behavioral implications of this method of communication is minimal.

Several authors have advanced hypotheses on the significance of scent marking. Most authors believe that canids can recognize individual odors (Mech, 1970; Scott and Fuller, 1965; Young and Goldman, 1944). Mech also suggests that wolves (*Canis lupus*) can determine the age of a scent. Lorenz (1954) states that dogs can infer the size of the animal from scent marks, while Scott and Fuller (1965) and Beach and Gilmore (1949) emphasize the importance of scent in reproduction. The function of odors as "general information disseminators" has been supported by several authors (Mech, 1970; Schenkel, 1948; Scott and Fuller, 1965). There may also be territorial implications in scent marking (Kleiman, 1966; Mech, 1970), although some authors disagree (Putter and Pimlott, 1968; Scott and Fuller, 1965). Many of these hypotheses, however, are based primarily on suppositions, with little or no experi-

mental evidence to support them.

In addition to the fact that we know little about what odors a canid can distinguish, two problems complicate the matter even more. Firstly, what effect does a scent have on the animal that smells it, and secondly, what is the motivation of the marker? Ewer (1968), after summarizing the current literature, concluded that the response exhibited by mammals after encountering a scent depends on who made the mark, and where it is. The odor of the animal's own mark tends to increase confidence or reduce tendency to escape, while the response toward a foreign mark depends on where it is. If this scent is on the responder's home ground, there is a tendency towards increased aggression and readiness to fight. If however, the scent is off the responder's home ground, decreased confidence and readiness to flee are the result. If this is true, it would aid in explaining many of the marking patterns which occur in nature. However, it does not solve the problem of the effects that particular scents have on the behavior of an animal.

The motivation of the marker is a problem that is even more obscure. Ralls (1971) states that vigorous marking occurs when an animal is motivated to aggression, but further remarks that little is known about the motivation of less vigorous marking. Ewer (1968), however, is more cautious. She states that the factors which evoke marking, particularly marking that involves more than one source of scent, will "remain beyond our microsmic comprehension for some time to come."

DISCUSSION OF AIMS

Scent marking under natural conditions is frequently observed, but rarely understood. Typically, these observations consist of seeing an animal approach an object, explore it, and then mark it. The result is that the basic characteristics of scent marking, those of morphological descriptions and/or environmental aspects, have been relatively well investigated. However, it is quite another thing to determine the significance of marking in the life of the species. The primary reasons for this are that in field studies, there are many uncontrollable variables, and the chance of observing a specific animal under duplicate conditions is rare. These reasons necessitate that research on the "why" of scent marking must start in a laboratory where experimental conditions can be duplicated. The data that are obtained can then be utilized in a field study to determine why an animal scent marks.

This study was undertaken in controlled laboratory conditions to survey the responses of captive coyotes to certain canid scents. The test odors used were urine and feces from coyotes of various age, sex, social status, and reproductive conditions. Since male and female coyotes exhibit a seasonal reproductive cycle (Hamlett, 1938), domestic dog eliminations were also used to test for seasonal variation in the responses exhibited to scents from adult females (estrus and anestrus), and from sexually mature males. The domestic dog provided a readily available source for these eliminations, since females exhibit estrus in any season (Scott and Fuller, 1965), and males do not have a sexual cycle (Fuller and Du Buis, 1962). In addition, domestic dog eliminations should also be, at least in part, of biological significance to coyotes, since coyote-dog

crosses are frequent in nature (Young and Jackson, 1951). For a discussion of the possible meanings of dog odors, refer to "Discussion".

This study was designed, primarily, to examine two questions:

1. Do coyotes respond differentially to various samples of urine and feces?

2. Is there any association between the scent examined and the response (if any) elicited?

In addition, an attempt was also made to determine if there were any behavioral clues exhibited in response to a scent that could give an indication of its meaning and/or the motivation of the animals involved. This possibility was examined by using the three methods that Ralls (1971, p. 447) gives for inferring the motivation of a given act. These are "in order of increasing strength:

1. Fine morphological analysis, whereby one shows that the given act, a fragment of a display, is identical to a fragment of another display with a known motivation.

2. Correlation of the act with stimulus situations which cause a known motivational state.

3. Close temporal association of the act with acts which result from a known motivational state."

By minimizing the territorial components, eliminating the influence of other animals, and controlling as many variables as feasible, these questions were examined by repeatedly exposing coyotes of known life history to various urine and fecal samples. Any consistent deviation in the behavior of any of the animals would suggest that the first two questions are answerable, and would provide basic information on this mode of communication. Inferences on meaning and/or motivation, however, should be made with caution, because many of the factors that are normally associated with responses to odors were eliminated, or reduced during this study.

BACKGROUND INFORMATION ON THE ANIMALS

The Animals Studied

This study involved the use of nine coyotes (Fig. 1) held in captivity. These animals were obtained from two different litters (1969 and 1970) of the same parents, and were born in captivity at the Bio-Science Vivarium, 6 miles south of Edmonton, Alberta. The animals were removed from the parents at 10 days of age and hand-raised. Until weaning at 4 weeks of age, they were fed Esbilac, an artificial dog bitch milk.

Identification of the Animals

The coyotes utilized were all marked at 11 days of age by cutting a notch in a specific location on one of the pinnae. This provided a reliable and rapid means of identification of the animals.

Housing the Animals

The coyotes were housed in individual cages in a room located in the Bio-Science Building at the University of Alberta, Edmonton, Alberta. Six of the cages, measuring 2 by 3 by 6 feet, were constructed with Dexion metal frames and 1-inch mesh wire, and were elevated 3 feet off the floor. The remaining 3 cages were fiber-glass dog cages measuring 3 by 3 by 3 feet. All of the cages were visually isolated from each other.

The Coyote Groups

All animals were housed, and tested, individually during this study. Intraspecific contact occurred only during regular exercise periods which were approximately 2 hours long. There were three or four exercise periods a week, depending on which series of experiments was in progress.

The composition of the exercise group was the same as the test group (see "Description of Scent Experiments").

The social status of each animal within each group of animals was determined during the exercise periods by examining the general postures and patterns associated with rank (Fox, 1969; Fox, 1970).

Environmental Variables

The solar photoperiod at Edmonton, Alberta varies during the year from approximately 7 hours daylight in December to approximately 17 hours in June. The short daylight period during the winter, however, would not accommodate my observation schedule. Because of this, the light period in the animal quarters was set to vary in phase with the outside light, but with a minimum day of 12 hours and a maximum day of 17 hours. The light period in the animal quarters commenced at 0700 hours throughout the year. The temperature was maintained at 18-21 C and the relative humidity at 50-60% throughout the year.

Diet and Disease

The coyotes were fed a mixture of a high-quality dog meal and ground horse meat. Equal quantities of each were mixed, soaked with water, and frozen in 3-cup packages. Each animal received one of these packages daily, at approximately 1600 hours, while in their individual cages. Bones were provided for gnawing, and water was constantly available.

The elevated floors of the cages minimized the risk of disease and parasites since elimination fell through the floor. The cages and room were cleaned twice daily, at approximately 0800 and 1600 hours.

Biannual examinations of the feces by the method of Levine et al. (1960) for internal parasites were made. The only parasite encountered

was *Toxascaris leonina*, an intestinal roundworm. Only once was the parasite load considered heavy enough to de-worm the coyotes with Pipcide, an anthelminthic for ascarids.

All of the animals from the 1969 litter (Fig. 1) were given injections for distemper and hepatitis when they were 5 months of age. One animal from this litter (coyote L) died as a result of the injections, so none of the animals from the 1970 litter were given this injection. No problems with distemper or hepatitis were encountered during this study.

GENERAL EXPERIMENTAL TECHNIQUES

Technique of Collecting Scent

Urine and feces from the coyotes were collected once a week by placing collecting pans under the slotted floor of the fiber-glass cages. The pans were left in the cages overnight, and the samples were collected in the morning. The urine and feces were handled in a controlled manner.

Urine and feces from male dogs and female dogs not in estrus were obtained once a week from the Medical Vivarium at Ellerslie, 6 miles south of Edmonton, Alberta. Samples from females in estrus were also collected from the Medical Vivarium, although the scarcity of these animals necessitated gathering a large sample whenever possible, and freezing it for future use. Eliminations were obtained from a different animal each time they were collected.

The possibility that diet affects the odor of eliminations was examined by changing the diet of the domestic dogs utilized during the "Series One Experiments" (see "Description of Scent Experiments"). The diet was rotated between the vivarium diet (dog meal) and the coyote diet (dog meal plus horse meat), with the change being made one week before the samples were collected. No differences were detected, so future samples were taken from dogs maintained on the vivarium diet.

Basic Experimental Design

This study involved exposing known coyotes, one at a time, to various canid scents presented one at a time in successive tests, and recording the responses exhibited. The experiments were conducted in an observation room equipped with one-way glass, and the apparatus consisted of two metal posts (Fig. 2) and an automatic release cage (Fig. 3). The

spatial organization of these is shown in Fig. 4. The metal posts were located at sites where the air currents in the room moved from them directly to the release cage.

In all of the scent experiments, one metal post served as the odor post, and the other as the control post. The odor post contained the test odor which was either a canid elimination or a control. The control which occurred at the odor post is called the no-odor post, as opposed to the regular control post.

The posts were constructed of two metal cylinders and a metal base (Fig. 2). The inner cylinder was attached to the base, and was designed to hold an 8-dram vial containing the test scent. The outer cylinder was removable, and functioned to protect the odor source from contamination.

The automatic release cage (Fig. 3) functioned on a counter-balance system. A timer held the door closed, and when released, a weight opened the door. This apparatus permitted placing an animal in the test situation, and recording its behavior immediately on release.

Technique of Recording Behavior

The occurrence and duration of specific behavioral parameters were recorded by using a push-button keyboard which activated an Esterline-Angus (Model A620X) event recorder (Fig. 5). Each button, or combination of buttons represented a specific parameter. One button (no. 20) activated a tape recorder which was used to record the occurrence of parameters not included in the other 19 buttons. The chart speed of the recorder was 3 inches per minute.

The location of specific behavioral patterns, when recorded, were based on the imaginary grid shown in Fig. 4.

Technique of Masking Undesirable Odors

Prior to each experimental period, the observation room was washed with a deodorizer-disinfectant solution (3 tablespoons A33 to 1 gallon water). The bulk of the solution was then removed with a rubber scraper.

The effectiveness of this technique for masking undesirable odors was examined over the period December 19 to 22, 1969. The test was conducted in a room at the Bio-Science Vivarium using coyotes I, J, and K (Fig. 1). This experiment was designed to investigate two points. Firstly, whether or not the technique of scent-masking would eliminate, or mask the odor of urine, and secondly, whether or not the residual odor of the masking technique would cover an introduced odor. The results (Fig. 6) suggest that the experimental technique standardizes the environmental odors, yet permits the animals to detect introduced odors.

Testing Procedure

Before commencing a day of experiments, the metal posts and automatic release cage were placed in the observation room (Fig. 4), and the recording apparatus (Fig. 5) prepared. The vials containing the test odors were removed from a refrigerator (maintained at 2 C) and allowed to equilibrate with room temperature (18-21 C). A foot-bath containing the deodorizer solution used in washing the room was placed outside the door to the observation room. Before entering the experimental area, this solution was walked through to minimize the placement of odors in the room.

When the animals were carried to the observation area, they were placed in individual holding cages outside the observation room. They were held in these cages for approximately 30 minutes prior to the start

of the experiments.

The procedure followed for each experiment was regimented, and consisted of the following steps:

1. Wash room, posts, and release cage with deodorizer-disinfectant solution.

2. Remove excess solution from floor with rubber scrapper and flush drain.

3. With tongs, place vial containing test odor (randomized) in one of the posts (randomized) and remove cap of vial with pliers (tongs and pliers kept in deodorizer solution).

4. With pliers, place protective cover on both posts.

5. Close front door on release cage and set timer at one minute.

6. With removable handle, move release cage to door of observation room and open rear door of cage.

7. Leave observation room, get test animal (randomized), and after stepping in foot-bath, place animal in release cage through rear door.

8. With removable handle, move release cage into room and place cage in position with rear door against wall.

9. Reset timer to 30 seconds, leave room, go to upper level of observation room and prepare to record behavior of released animal.

10. After the experiment, remove animal, then remove test odor, and start again.

The first series of experiments (see "Series One Experiments") were of 10 minutes duration. Following these experiments, the temporal distribution of time spent at the odor post was analysed. The resultant data (Fig. 7) indicate a rapid reduction in time at the post during the first 5 minutes, after which little contact was made. For this reason, all of the later experiments were conducted on a 5 minute time limit.

Technique of Analysing Data

The data obtained during the scent experiments were analysed only for occurrence, or total duration of a specific act. No attempt was made

to do a sequential analysis of patterns within an experiment. The data were analysed with the aid of APL\360 computer language.

The statistical procedures involved in this study are from Steel and Torrie (1960), and Sokal and Rohlf (1969). In all cases, the null hypothesis was rejected when the probability level was less than or equal to 0.1, although emphasis was placed on those data that were significant at the 5% level of probability. If a test required a set of values from a statistical table, the critical values used were at the 5% level of probability.

DESCRIPTION OF SCENT EXPERIMENTS

A code will be used to describe the test animals and odors utilized. This code will consist of a maximum of three letters and two numbers arranged in the following manner:

1. Group (G) vs. Non-group (N)
2. Puppy (P) vs. Juvenile (J) vs. Adult (A)
3. Male (M) vs. Female (F)
4. Group Rank
5. Number of Animals in Group

With this scheme, Group (G) or Non-group (N) will only be used to classify the test odors. Group (G) will refer to the test odors from the group of animals being tested in each experiment. Non-group (N) will refer to the urine and feces from coyotes outside the test group.

Puppy (P) will refer to all coyotes prior to the start of the juvenile period at 12 weeks of age (Scott and Fuller, 1965). Juvenile (J) will refer to males that have not exhibited marking behavior. In this study, the males did not scent mark until 12 to 14 months of age. A juvenile female is one that has not exhibited estrus. Estrus occurred at 10 months of age.

By using this code, coyote J, an adult male that was the subordinate animal in a group of three animals, would be represented as AM3-3. If coyote J were tested with an odor from coyote M, a juvenile male that was dominant in a different group of three animals, the odor from coyote M would be represented as N-JM1-3.

Series One Experiments

Urine Experiment

The group of animals used in this experiment was:

1. coyote K (AM1-3)
2. coyote I (AM2-3)
3. coyote J (AM3-3)

These animals were from the same litter (Fig. 1), and were 14 months of age when the experiment was started. The test odors used in this experiment were urine from:

1. coyote K (G-AM1-3)
2. coyote I (G-AM2-3)
3. coyote J (G-AM3-3)
4. coyote M (N-PM1-3)
5. coyote O (N-PF2-3)
6. coyote N (N-PF3-3)
7. male domestic dog
8. female domestic dog (anestrus)
9. female domestic dog (estrus)
10. no odor

Coyotes M, O, and N were a group of coyotes that were 8 weeks of age at the start of the experiment. The domestic dogs were all adults, and the urine samples were from a different animal each week. The test animals had no previous contact with the non-group animals, or with the domestic dogs.

Feces Experiment

This experiment was the same as the "Urine Experiment", with the exception that fecal samples were used.

Behavior Recorded

The behavioral parameters recorded during the "Series One Experiments" were:

1. Active time
2. Inactive time
3. Olfactory exploration of room during active time
4. Olfactory exploration of room during inactive time
5. Total time at post
6. Time rubbing post

These parameters were recorded in both halves of the room, with one

side containing the odor post, the other the control post. In addition, the tape recorder was utilized to note urination and defecation sites, as well as miscellaneous behavioral patterns.

Observation Schedule

The "Urine and Feces Experiments" extended over the period June 22 to August 20, 1970. Each animal, in each experiment, was exposed individually and successively to the nine odors and the control (no odor) over two days. The urine test was run on days 1 and 3, while the feces test was run on days 2 and 4. This procedure was repeated for four consecutive weeks. After one week with no experiments, another four week test period was run. This resulted in a sample size of eight for each animal-scent combination.

Series Two Experiments

Experiment With K-I-J Subjects (K-I-J Experiment)

The group of animals used in this experiment was:

1. coyote K (AM1-3)
2. coyote I (AM2-3)
3. coyote J (AM3-3)

These animals were from the same litter (Fig. 1), and were 17 months of age when the experiment was started. The test odors used in this experiment were:

1. Urine - coyote K (G-AM1-3)
2. Feces - "
3. Urine - coyote I (G-AM2-3)
4. Feces - "
5. Urine - coyote J (G-AM3-3)
6. Feces - "
7. Urine - male domestic dog
8. Feces - "
9. Urine - female domestic dog (anestrus)
10. Feces - "

11. Urine - female domestic dog (estrus)
12. Feces - "
13. No odor

The domestic dogs were all adults, and the eliminations were from a different animal each week.

Experiment With M-O-N Subjects (M-O-N Experiment)

The group of animals used in this experiment was:

1. coyote M (JM1-3)
2. coyote O (JF2-3)
3. coyote N (JF3-3)

These animals were from the same litter (Fig. 1) and were 5 months of age when the experiment was started. The test odors used in this experiment were:

1. Urine - coyote M (G-JM1-3)
2. Feces - "
3. Urine - coyote O (G-JF2-3)
4. Feces - "
5. Urine - coyote N (G-JF3-3)
6. Feces - "
7. Urine - coyote P (N-JM1-3)
8. Feces - "
9. Urine - coyote Q (N-JF2-3)
10. Feces - "
11. Urine - coyote S (N-JF3-3)
12. Feces - "
13. No odor

Coyotes P, Q, and S were from the same litter as coyotes M, O, and N (Fig. 1). These two groups of animals were separated at 10 days of age, and were maintained as separate groups until this series of experiments was completed.

Experiment With P-Q-S Subjects (P-Q-S Experiment)

The group of animals used in this experiment was:

1. coyote P (JM1-3)
2. coyote Q (JF2-3)
3. coyote S (JF3-3)

The test odors used in this experiment were:

1. Urine - coyote P (G-JM1-3)
2. Feces - "
3. Urine - coyote Q (G-JF2-3)
4. Feces - "
5. Urine - coyote S (G-JF3-3)
6. Feces - "
7. Urine - coyote M (N-JM1-3)
8. Feces - "
9. Urine - coyote O (N-JF2-3)
10. Feces - "
11. Urine - coyote N (N-JF3-3)
12. Feces - "
13. No odor

The background information on the animals used in this experiment is given in the preceding experiment (M-O-N Experiment).

Behavior Recorded

The behavioral parameters recorded during the "Series Two Experiments" were:

1. Active time
2. Inactive time
3. Olfactory exploration of room during active time
4. Olfactory exploration of room during inactive time
5. Total time at post
6. Time rubbing post
7. Time pawing and biting post
8. Duration of eliminative postures at post
9. Time gnawing objects in room
10. Time in release cage
11. Time playing

Parameters 1-8 were recorded in both halves of the room, with one side containing the odor post, the other the control post. In addition, the tape recorder was utilized to note urination and defecation sites, as well as miscellaneous behavioral patterns. Parameters 7-11 were not analysed.

Observation Schedule

In each of the "Series Two Experiments", 20 of the 39 animal-scent combinations were run in the morning of one day, and the remaining 19

combinations in the afternoon of the following day. Each animal was tested with each scent once a week for two weeks, followed by a week of no experiments.

These experiments commenced on September 14, 1970. The "M-O-N Experiment" was terminated on February 3, 1971, resulting in a sample size of 14 for each animal-scent combination. The "K-I-J and P-Q-S Experiments" were terminated on February 25, 1971, resulting in a sample size of 16.

Series Three Experiments

Experiment With K-I-O-S Subjects (K-I-O-S Experiment)

The group of animals used in this experiment was:

1. coyote K (AM1-4)
2. coyote I (AM2-4)
3. coyote O (AF3-4)
4. coyote S (AF4-4)

These animals were from two different litters (Fig. 1). Coyotes K and I were from one litter, and were always in the same group during this study. Coyotes O and S were from a different litter, and were separated at 10 days of age. These 4 animals were combined in a group 20 days before this experiment was started. At the start of this experiment, coyotes K and I were 23 months of age, and coyotes O and S were 11 months of age. The test odors used in this experiment were:

1. Urine - coyote M (N-JM1-4)
2. Feces - "
3. Urine - coyote P (N-JM2-4)
4. Feces - "
5. Urine - coyote Q (N-AF3-4)
6. Feces - "
7. Urine - coyote N (N-AF4-4)
8. Feces - "
9. No odor

Coyotes M, P, Q, and N were from the same litter (Fig. 1), but were

separated into 2 different groups at 10 days of age. Coyotes M and N were in one group, and coyotes P and Q in another. These 4 animals were combined in a group 20 days before this experiment was started. These animals were 11 months of age at the start of this experiment.

Experiment With M-P-Q-N Subjects (M-P-Q-N Experiment)

The group of animals used in this experiment was:

1. coyote M (JM1-4)
2. coyote P (JM2-4)
3. coyote Q (AF3-4)
4. coyote N (AF4-4)

The test odors used in this experiment were:

1. Urine - coyote K (N-AM1-4)
2. Feces - "
3. Urine - coyote I (N-AM2-4)
4. Feces - "
5. Urine - coyote O (N-AF3-4)
6. Feces - "
7. Urine - coyote S (N-AF4-4)
8. Feces - "
9. No odor

The background information on the coyotes used in this experiment is given in the preceding experiment (K-I-O-S Experiment).

Behavior Recorded

The behavioral parameters recorded during the "Series Three Experiments" were:

1. Active time
2. Inactive time
3. Olfactory exploration of room during active time
4. Olfactory exploration of room during inactive time
5. Total time at post
6. Time rubbing post
7. Time pawing post
8. Time biting post
9. Time licking post
10. Time looking at post
11. Duration of eliminative postures at post
12. Time gnawing objects in room
13. Time playing

Parameters 5-11 were recorded for the post classification of:

1. Clean post
2. Post which had been urinated on
3. Post which had been defecated on
4. Post which had been rubbed
5. Post which had been exposed to at least two of the preceding three patterns

Parameters 1-11 were recorded in both halves of the room, with one side containing the odor post, the other the control post. In addition, the tape recorder was utilized to note urination and defecation sites, as well as miscellaneous behavioral patterns. Parameters 7-13 were not analysed.

Observation Schedule

In each of the "Series Three Experiments", 18 of the 36 animal-scent combinations were run in the morning of one day, and the remaining 18 combinations in the morning of the third day. The two experiments alternated between days 1 and 3, and days 2 and 4. Each animal was tested with each scent once a week for two weeks, followed by a week with no experiments.

These experiments commenced on March 30, 1971. The "M-P-Q-N Experiment" was terminated on June 11, 1971, resulting in a sample size of 8 for each animal-scent combination. The "K-I-O-S Experiment" was terminated on July 22, 1971, resulting in a sample size of 12.

STATISTICAL ANALYSIS OF RESULTS

This section will involve the presentation and statistical analysis of the data. For the discussion of these results, refer to "Discussion".

When applicable, the "rank-underscore" technique (Steel and Torrie, 1960, p. 109) will be used to illustrate differences in the data. This technique (henceforth referred to as RUT) involves ranking the data in ascending order from left to right, and underscoring those values which are not significantly different from each other. When the RUT is used to illustrate differences between animals, the letter and code of each animal will be presented. When the differences are between weeks of the experiment, numbers representing the actual week of the experiment will be used. When the differences are between odors, numbers representing specific odors will be used, and the RUT illustration will be followed by the number-odor code.

Total Time in Side of Room With Odor Post

The total time in the side of the room containing the odor post was recorded during all of the scent experiments. The resultant data were analysed with a three-factor (animal, odor, and week) analysis of variance. There was no significant variation in the data from any of the scent experiments (Table 1).

General Activity

The general activity exhibited by the study animals was recorded during all of the scent experiments. This parameter was recorded for both sides of the room (odor and control side). The data from each experiment on the general activity exhibited on the side of the room

Table 1. Total time the study animals spent in the side of the room containing the odor post during the various scent experiments.

Experiment	Coyote	Total Time (%) in Side of Room Containing Odor Post
Urine	K (AM1-3)	50.6
	I (AM2-3)	51.0
	J (AM3-3)	50.2
Feces	K (AM1-3)	51.7
	I (AM2-3)	51.5
	J (AM3-3)	52.5
K-I-J	K (AM1-3)	49.9
	I (AM2-3)	52.6
	J (AM3-3)	51.0
M-O-N	M (JM1-3)	51.6
	O (JF2-3)	48.8
	N (JF3-3)	49.8
P-Q-S	P (JM1-3)	51.4
	Q (JF2-3)	49.8
	S (JF3-3)	50.3
K-I-O-S	K (AM1-4)	51.4
	I (AM2-4)	52.2
	O (AF3-4)	50.7
	S (AF4-4)	51.5
M-P-Q-N	M (JM1-4)	49.6
	P (JM2-4)	50.2
	Q (AF3-4)	50.4
	N (AF4-4)	50.8

containing the odor post, the side containing the control post, and the combined total were analysed with a three-factor (animal, odor, and week) analysis of variance. Duncan's New Multiple Range Test ($P \leq 0.05$) was used to compare the means of the main effects if there was significant variation in the data.

For the "Urine Experiment", the analysis of the data on general activity indicates that:

1. For the odor side of the room, the control side, and the combined total, the variance component of the "between-animals" main effect (Fig. 8) was significant ($P \leq 0.001$). The RUT shows:

   I (AM2-3)   K (AM1-3)   J (AM3-3)

2. For the odor side of the room, the variance component of the "between-weeks" main effect (Fig. 8) was significant ($P \leq 0.001$). The RUT shows:

   4 3 6 1 2 8 5 7

3. For the control side of the room, the variance component of the "between-weeks" main effect (Fig. 8) was significant ($P \leq 0.001$). The RUT shows:

   4 3 1 6 2 8 7 5

4. For the total activity, the variance component of the "between-weeks" main effect (Fig. 8) was significant ($P \leq 0.001$). The RUT shows:

   4 3 1 6 2 8 7 5

5. For the odor side of the room, the control side, and the combined total, there was a significant animal-week interaction ($P \leq 0.001$). The variation in these data appears to be the result of the high

level of activity exhibited by coyote J (AM3-3) during weeks 2-4, when coyotes K (AM1-3) and I (AM2-3) showed a decrease in activity (Fig. 8).

For the "Feces Experiment", the analysis of the data on general activity indicates that:

1. For the odor side of the room, the control side, and the combined total, the variance component of the "between-animals" main effect (Fig. 9) was significant (P≤0.001). The RUT shows:

   I (AM2-3) K (AM1-3) J (AM3-3)

2. For the odor side of the room, the variance component of the "between-weeks" main effect (Fig. 9) was significant (P≤0.025). The RUT shows:

   1 4 3 2 8 6 7 5

3. For the control side of the room, the variance component of the "between-weeks" main effect (Fig. 9) was significant (P≤0.025). The RUT shows:

   1 2 3 4 7 8 6 5

4. For the total activity, the variance component of the "between-weeks" main effect (Fig. 9) was significant (P≤0.005). The RUT shows:

   1 2 3 4 8 7 6 5

5. For the odor side of the room, the control side, and the combined total, there was a significant animal-week interaction (P≤0.005, 0.001, and 0.001, respectively). The variation in these data appears to be the result of the increase in activity exhibited by

coyote J (AM3-3) during weeks 1-4 (Fig. 9). Coyotes K (AM1-3) and I (AM2-3) showed decreasing activity during this time.

For the "K-I-J Experiment", the analysis of the data on general activity indicates that:

1. For the odor side of the room, the control side, and the combined total, the variance component of the "between-animals" main effect (Fig. 10) was significant (P≤0.001). The RUT shows:

   I (AM2-3)   K (AM1-3)   J (AM3-3)

2. For the odor side of the room, the variance component of the "between-weeks" main effect (Fig. 11) was significant (P≤0.001). The RUT shows:

   14 11 4 7 12 6 8 10 5 1 2 13 9 3 16 15

3. For the control side of the room, the variance component of the "between-odors" main effect (Fig. 10) was significant (P≤0.1). The RUT shows:

   9 11 8 12 5 1 6 7 3 13 10 2 4

   4 = Feces - coyote I (G-AM2-3)
   2 = Feces - coyote K (G-AM1-3)
   10 = Feces - female domestic dog (anestrus)
   13 = No odor
   3 = Urine - coyote I (G-AM2-3)
   7 = Urine - male domestic dog
   6 = Feces - coyote J (G-AM3-3)
   1 = Urine - coyote K (G-AM1-3)
   5 = Urine - coyote J (G-AM3-3)
   12 = Feces - female domestic dog (estrus)
   8 = Feces - male domestic dog
   11 = Urine - female domestic dog (estrus)
   9 = Urine - female domestic dog (anestrus)

4. For the control side of the room, the variance component of the

"between-weeks" main effect (Fig. 11) was significant (P≤0.001). The RUT shows:

12 10 5 11 14 6 1 8 9 4 7 3 2 13 16 15

5. For the total activity, the variance component of the "between-odors" main effect (Fig. 10) was significant (P≤0.05). The RUT shows:

9 11 7 13 1 5 8 3 6 10 12 2 4

4 = Feces - coyote I (G-AM2-3)
2 = Feces - coyote K (G-AM1-3)
12 = Feces - female domestic dog (estrus)
10 - Feces - female domestic dog (anestrus)
6 = Feces - coyote J (G-AM3-3)
3 = Urine - coyote I (G-AM2-3)
8 = Feces - male domestic dog
5 = Urine - coyote J (G-AM3-3)
1 = Urine - coyote K (G-AM1-3)
13 = No odor
7 = Urine - male domestic dog
11 = Urine - female domestic dog (estrus)
9 = Urine - female domestic dog (anestrus)

6. For the total activity, the variance component of the "between-weeks" main effect (Fig. 11) was significant (P≤0.001). The RUT shows:

11 14 12 10 5 6 4 8 7 1 9 2 13 3 16 15

7. For the odor side of the room, the control side, and the combined total, there was a significant animal-week interaction (P≤0.001). The variation in these data appears to be the result of the increase in activity exhibited by coyote J (AM3-3) whenever coyotes K (AM1-3) and I (AM2-3) exhibited a decrease in activity (Fig. 11). Coyote J showed peaks in activity during week 1-3 and 9-12, while coyotes K and I showed peaks in activity

during weeks 5-9 and 13-16.

For the "M-O-N Experiment" the analysis of the data on general activity indicates that:

1. For the odor side of the room, the control side, and the combined total, the variance component of the "between-animals" main effect (Fig. 12) was significant (P≤0.001). The RUT shows:

   O (JF2-3) M (JM1-3) N (JF3-3)

2. For the odor side of the room, the variance component of the "between-weeks" main effect (Fig. 12) was significant (P≤0.001). The RUT shows:

   10 8 11 12 7 13 6 9 4 14 3 5 2 1

3. For the control side of the room, the variance component of the "between-weeks" main effect (Fig. 12) was significant (P≤0.1). The RUT shows:

   10 8 14 5 6 9 11 3 7 2 4 13 12 1

4. For the total activity, the variance component of the "between-weeks" main effect (Fig. 12) was significant (P≤0.001). The RUT shows:

   10 8 11 6 9 14 7 12 13 3 5 4 2 1

5. For the odor side of the room, the control side, and the combined total, there was a significant animal-week interaction (P≤0.005, 0.001, and 0.001, respectively). The variation in these data (Fig. 12) appears to be the result of the increased activity exhibited by coyote N (JF3-3) during weeks 11-14. Coyotes M

(JM1-3) and O (JF2-3) exhibited a tendency toward a reduction in activity as the experiment progressed.

For the "P-Q-S Experiment", the analysis of the data on general activity indicates that:

1. For the odor side of the room, the control side, and the combined total, the variance component of the "between-animals" main effect (Fig. 13) was significant ($P \leq 0.001$). The RUT shows:

   S (JF3-3) Q (JF2-3) P (JM1-3)

2. For the control side of the room, the variance component of the "between-weeks" main effect (Fig. 13) was significant ($P \leq 0.025$). The RUT shows:

   3 2 1 13 5 10 12 14 4 6 11 9 8 7 15 16

3. For the total activity, the variance component of the "between-weeks" main effect (Fig. 13) was significant ($P \leq 0.01$). The RUT shows:

   2 3 10 1 13 14 5 12 6 4 15 11 7 9 8 16

4. For the odor side of the room, the control side, and the combined total, there was a significant animal-week interaction ($P \leq 0.001$). The variation in these data (Fig. 13) appears to be the result of the peak in activity exhibited by coyote P (JM1-3) during weeks 7-8. Coyote Q (JF2-3) exhibited a tendency toward increased activity as the experiment progressed, while coyote S (JF3-3) was relatively consistent in her activity, except for a slight reduction during weeks 10-12.

For the "K-I-O-S Experiment", the analysis of the data on general

activity indicates that:

1. For the odor side of the room, the control side, and the combined total, the variance component of the "between-animals" main effect (Fig. 14) was significant ($P \le 0.001$). The RUT shows:

   O (AF3-4)   S (AF4-4)   I (AM2-4)   K (AM1-4)

2. For the odor side of the room, the variance component of the "between-weeks" main effect (Fig. 15) was significant ($P \le 0.001$). The RUT shows:

   5 1 8 6 7 4 2 10 3 9 12 11

3. For the total activity, the variance component of the "between-weeks" main effect (Fig. 15) was significant ($P \le 0.001$). The RUT shows:

   1 5 7 8 6 10 2 3 4 12 9 11

4. For the odor side of the room, and the total activity, there was a significant animal-week interaction ($P \le 0.005$). The significant variation in the total activity appears to be the result of the variation in the activity associated with the odor side of the room (Fig. 15). Coyote K (AM1-4) exhibited a tendency toward increasing activity over time, while coyote O (AF3-4) showed a relatively consistent level of activity throughout the experiment. Coyotes I (AM2-4) and S (AF4-4) exhibited a peak in activity during week 3, a low level of activity during week 5, and then a relatively consistent increase in activity until the end of the experiment.

For the "M-P-Q-N Experiment", the analysis of the data on general activity indicates that:

1. For the odor side of the room, the variance component of the "between-animals" main effect (Fig. 16) was significant (P≤0.001).

   The RUT shows:

   M (JM1-4)   Q (AF3-4)   N (AF4-4)   P (JM2-4)

2. For the odor side of the room, the variance component of the "between-weeks" main effect (Fig. 17) was significant (P≤0.025).

   The RUT shows:

   2 4 3 8 7 6 1 5

3. For the control side of the room, the variance component of the "between-animals" main effect (Fig. 16) was significant (P≤0.001).

   The RUT shows:

   Q (AF3-4)   M (JM1-4)   N (AF4-4)   P (JM2-4)

4. For the control side of the room, the variance component of the "between-odors" main effect (Fig. 16) was significant (P≤0.01).

   The RUT shows:

   1 7 5 8 3 9 6 4 2

   2 = Feces - coyote K (N-AM1-4)
   4 = Feces - coyote I (N-AM2-4)
   6 = Feces - coyote O (N-AF3-4)
   9 = No odor
   3 = Urine - coyote I (N-AM2-4)
   8 = Feces - coyote S (N-AF4-4)
   5 = Urine - coyote O (N-AF3-4)
   7 = Urine - coyote S (N-AF4-4)
   1 = Urine - coyote K (N-AM1-4)

5. For the total activity, the variance component of the "between-animals" main effect (Fig. 16) was significant (P≤0.001).

   The RUT shows:

   M (JM1-4)   Q (AF3-4)   N (AF4-4)   P (JM2-4)

6. For the total activity, the variance component of the "between-

odors" main effect (Fig. 16) was significant ($P \leq 0.025$). The RUT shows:

7 1 9 8 5 4 3 6 2

2 = Feces - coyote K (N-AM1-4)
6 = Feces - coyote O (N-AF3-4)
3 = Urine - coyote I (N-AM2-4)
4 = Feces - coyote I (N-AM2-4)
5 = Urine - coyote O (N-AF3-4)
8 = Feces - coyote S (N-AF4-4)
9 = No odor
1 = Urine - coyote K (N-AM1-4)
7 = Urine - coyote S (N-AF4-4)

7. For the odor side of the room, the control side, and the combined total, there was a significant animal-week interaction ($P \leq 0.001$). Coyote M (JM1-4) exhibited a tendency toward a higher level of activity in the latter half of the experiment, while coyote P (JM2-4) showed increased activity during weeks 5 and 8 (Fig. 17). Coyote Q (AF3-4) exhibited a peak in activity during weeks 3-4, and coyote N (AF4-4) was constant in the level of activity throughout the experiment.

Olfactory Exploration of the Room

Olfactory exploration of the observation room by the study animals was recorded during all of the scent experiments. The recording of this parameter was restricted to olfactory exploration that was directed toward, and in close proximity to a specific site. Sniffing the air with the head held high and sniffing the experimental posts were not included in these data. This pattern was recorded for both sides of the room (odor and control side).

The data from each experiment on the olfactory exploration exhibited in the side of the room containing the odor post, the side containing the

control post, and the combined total were analysed with a three-factor (animal, odor, and week) analysis of variance. Duncan's New Multiple Range Test ($P \leq 0.05$) was used to compare the means of the main effects if there was significant variation in the data.

For the "Urine Experiment", the analysis of the data on room exploration indicates that:

1. For the total exploration of the room, the variance component of the "between-animals" main effect (Fig. 18) was significant ($P \leq 0.05$). The RUT shows:

   J (AM3-3) I (AM2-3) K (AM1-3)

2. For the total exploration of the room, the variance component of the "between-weeks" main effect (Fig. 18) was significant ($P \leq 0.1$). The RUT shows:

   4 8 3 5 7 6 2 1

3. For the total exploration of the room, there was a significant animal-week interaction ($P \leq 0.025$). The variation in these data appears to be associated with the trend for coyotes K (AM1-3) and I (AM2-3) to exhibit a decreasing amount of exploratory behavior over time, while coyote J (AM3-3) showed a decrease until week 4, an increase in week 5, and a decrease until week 8 (Fig. 18).

For the "Feces Experiment", the analysis of the data on room exploration indicates that:

1. For the odor side of the room, the variance component of the "between-weeks" main effect (Fig. 19) was significant ($P \leq 0.1$). The RUT shows:

   5 7 8 4 3 6 1 2

2. For the control side of the room, the variance component of the "between-animals" main effect (Fig. 19) was significant (P≤0.05). The RUT shows:

   J (AM3-3) K (AM1-3) I (AM2-3)

3. For the total exploration of the room, the variance component of the "between-animals" main effect (Fig. 19) was significant (P≤0.1). The RUT shows:

   J (AM3-3) I (AM2-3) K (AM1-3)

4. For the total exploration of the room, the variance component of the "between-weeks" main effect (Fig. 19) was significant (P≤0.05). The RUT shows:

   5 7 8 3 4 6 2 1

For the "K-I-J Experiment", the analysis of the data on room exploration indicates that:

1. For the odor side of the room, and for the total exploration of the room, the variance component of the "between-animals" main effect (Fig. 20) was significant (P≤0.001). The RUT shows:

   K (AM1-3) J (AM3-3) I (AM2-3)

2. For the odor side of the room, the variance component of the "between-weeks" main effect (Fig. 20) was significant (P≤0.001). The RUT shows:

   15 16 10 13 14 11 9 4 12 6 1 2 8 3 5 7

3. For the control side of the room, the variance component of the "between-weeks" main effect (Fig. 20) was significant (P≤0.001). The RUT shows:

16 15 10 9 12 8 13 6 4 5 14 11 1 2 7 3

4. For the total exploration of the room, the variance component of the "between-weeks" main effect (Fig. 20) was significant (P≤0.001). The RUT shows:

16 15 10 9 13 12 14 4 6 8 11 1 2 5 7 3

5. For the odor side of the room, and for the total exploration of the room, there was a significant animal-week interaction (P≤0.005 and 0.001, respectively). The variation in the data for total exploration may be the result of the variation associated with the odor side of the room (Fig. 20). Coyote K (AM1-3) exhibited two peaks in the amount of room exploration (weeks 3-5 and week 14), while coyote I (AM2-3) peaked during weeks 8-9, and coyote J (AM3-3) peaked during week 7.

For the "M-O-N Experiment", the analysis of the data on room exploration indicates that:

1. For the odor side of the room, the variance component of the "between-animals" main effect (Fig. 21) was significant (P≤0.001). The RUT shows:

O (JF2-3) M (JM1-3) N (JF3-3)

2. For the control side of the room, and for the total exploration of the room, the variance component of the "between-animals" main effect (Fig. 21) was significant (P≤0.001). The RUT shows:

O (JF2-3) M (JM1-3) N (JF3-3)

3. For the odor side of the room, the control side, and the combined

total, there was a significant animal-week interaction ($P \leq 0.001$, 0.01, and 0.001, respectively). Coyote M (JM1-3) exhibited a tendency toward more room exploration as the experiment progressed, while coyote O (JF2-3) exhibited a peak in exploration during weeks 3-5. Coyote N (JF3-3) showed two peaks (weeks 6 and 14) in the amount of exploration of the room exhibited (Fig. 21).

For the "P-Q-S Experiment", the analysis of the data on room exploration indicates that:

1. For the odor side of the room, the variance component of the "between-weeks" main effect (Fig. 22) was significant ($P \leq 0.001$). The RUT shows:

   4 1 3 2 11 10 12 8 13 6 9 16 7 15 5 14

2. For the control side of the room, the variance component of the "between-animals" main effect (Fig. 22) was significant ($P \leq 0.05$). The RUT shows:

   P (JM1-3) Q (JF2-3) S (JF3-3)

3. For the control side of the room, the variance component of the "between-weeks" main effect (Fig. 22) was significant ($P \leq 0.025$). The RUT shows:

   3 8 1 13 2 9 10 12 4 16 7 11 5 6 15 14

4. For the total exploration of the room, the variance component of the "between-weeks" main effect (Fig. 22) was significant ($P \leq 0.001$). The RUT shows:

   3 1 4 2 8 10 13 12 9 11 16 7 6 5 15 14

5. For the total exploration of the room, there was a significant animal-week interaction (P≤0.05). The variation in these data (Fig. 22) appears to result from the tendency for coyote Q (JF2-3) to exhibit a greater amount of room exploration than coyotes P (JM1-3) and S (JF3-3) did during weeks 7-13. Coyotes P and S showed two peaks (weeks 5-6 and 14-15) in the amount of room exploration exhibited.

For the "K-I-O-S Experiment", the analysis of the data on room exploration indicates that:

1. For the odor side of the room, the variance component of the "between-animals" main effect (Fig. 23) was significant (P≤0.001). The RUT shows:

   K (AM1-4) I (AM2-4) S (AF4-4) O (AF3-4)

2. For the odor side of the room, the variance component of the "between-odors" main effect (Fig. 23) was significant (P≤0.05). The RUT shows:

   8 1 5 4 3 7 6 2 9

   9 = No odor
   2 = Feces - coyote M (N-JM1-4)
   6 = Feces - coyote Q (N-AF3-4)
   7 = Urine - coyote N (N-AF4-4)
   3 = Urine - coyote P (N-JM2-4)
   4 = Feces - coyote P (N-JM2-4)
   5 = Urine - coyote Q (N-AF3-4)
   1 = Urine - coyote M (N-JM1-4)
   8 = Feces - coyote N (N-AF4-4)

3. For the odor side of the room, the variance component of the "between-weeks" main effect (Fig. 24) was significant (P≤0.025). The RUT shows:

   3 9 5 8 11 10 12 2 4 6 7 1

4. For the control side of the room, and for the total exploration of the room, the variance component of the "between-animals" main effect (Fig. 24) was significant (P≤0.001). The RUT shows:

   K (AM1-4)   I (AM2-4)   S (AF4-4)   O (AF3-4)

5. For the control side of the room, the variance component of the "between-weeks" main effect (Fig. 24) was significant (P≤0.05). The RUT shows:

   3 10 12 11 8 9 7 4 5 1 6 2

6. For the total exploration in the room, the variance component of the "between-weeks" main effect (Fig. 24) was significant (P≤0.01). The RUT shows:

   3 10 9 8 12 11 5 4 7 2 6 1

7. For the control side of the room, and for the total exploration in the room, there was a significant animal-week interaction (P≤0.01 and 0.05, respectively). The variation in the data for total exploration may be the result of the variation associated with the control side of the room (Fig. 24). Coyotes K (AM1-4) and I (AM2-4) showed a relatively constant decrease in the amount of room exploration exhibited as the experiment progressed, while coyote S (AF4-4) exhibited a tendency toward consistency in the amount of exploratory behavior. Coyote O (AF3-4) exhibited two peaks (weeks 6 and 12) in exploratory behavior.

For the "M-P-Q-N Experiment", the analysis of the data on room exploration indicates that:

1. For the odor side of the room, the variance component of the "between-animals" main effect (Fig. 25) was significant (P≤0.001).

The RUT shows:

M (JM1-4) P (JM2-4) N (AF4-4) Q (AF3-4)

2. For the control side of the room, and for the total exploration in the room, the variance component of the "between-animals" main effect (Fig. 25) was significant (P≤0.001). The RUT shows:

M (JM1-4) P (JM2-4) N (AF4-4) Q (AF3-4)

3. For the control side of the room, the variance component of the "between-weeks" main effect (Fig. 26) was significant (P≤0.001). The RUT shows:

1 8 5 6 3 2 4 7

4. For the total exploration in the room, the variance component of the "between-weeks" main effect (Fig. 26) was significant (P≤0.001). The RUT shows:

1 8 5 3 2 6 4 7

5. For the total exploration in the room, there was a significant animal-week interaction (P≤0.001). Coyote M (JM1-4) exhibited a relatively constant level of exploratory behavior throughout the experiment, while coyote P (JM2-4) exhibited increasing exploration until week 8, when a low level of room exploration was shown. Coyote Q (AF3-4) explored the room frequently, except during weeks 1, 5, and 8, while coyote N (AF4-4) exhibited increasing exploration throughout the experiment (Fig. 26).

Total Time At Experimental Posts

The total time that each study animal spent at both the odor and control post was recorded during all of the scent experiments. The data

from each experiment were analysed with a three-factor (animal, odor, and week) analysis of variance. Duncan's New Multiple Range Test ($P \leq 0.05$) was used to compare the means of the main effects if there was significant variation in the data.

For the "Urine Experiment", the analysis of the data on total time at the posts indicates that:

1. At the odor post, the variance component of the "between-odors" main effect (Fig. 27) was significant ($P \leq 0.001$). The RUT shows:

   3 10 6 2 1 5 4 9 8 7

   7 = Urine - male domestic dog
   8 = Urine - female domestic dog (anestrus)
   9 = Urine - female domestic dog (estrus)
   4 = Urine - coyote M (N-PM1-3)
   5 = Urine - coyote O (N-PF2-3)
   1 = Urine - coyote K (G-AM1-3)
   2 = Urine - coyote I (G-AM2-3)
   6 = Urine - coyote N (N-PF3-3)
   10 = No odor
   3 = Urine - coyote J (G-AM3-3)

2. At the odor post, there was a significant animal-odor interaction ($P \leq 0.025$). This variation may be associated with increased time that coyote I (AM2-3) spent at the posts containing urine from domestic dogs (Fig. 27).

3. At the odor post, there was a significant animal-week interaction ($P \leq 0.1$). Coyote K (AM1-3) showed a decrease in total time at the post until week 4, followed by increased time during weeks 5-6, and decreased time during weeks 7-8. Coyote I (AM2-3) exhibited a relatively consistent decrease in time spent at the post as the experiment progressed. Coyote J (AM3-3) exhibited an increasing amount of time at the post until week 4, and low amounts of time during weeks 5-8 (Fig. 28).

4. At the odor post, there was a significant odor-week interaction ($P \leq 0.01$). The data (Fig. 29) suggest that the variation may be associated with urine from domestic dogs.

5. At the control post, the variance component of the "between-weeks" main effect (Fig. 28) was significant ($P \leq 0.1$). The RUT shows:

   8 4 7 6 5 2 1 3

For the "Feces Experiment", the analysis of the data on total time at the posts indicates that:

1. At the odor post, the variance component of the "between-odors" main effect (Fig. 30) was significant ($P \leq 0.001$). The RUT shows:

   5
   1 10 2 3 4 9 6 7 8

   8 = Feces - female domestic dog (anestrus)
   7 = Feces - male domestic dog
   6 = Feces - coyote N (N-PF3-3)
   5 = Feces - coyote O (N-PF2-3)
   9 = Feces - female domestic dog (estrus)
   4 = Feces - coyote M (N-PM1-3)
   3 = Feces - coyote J (G-AM3-3)
   2 = Feces - coyote I (G-AM2-3)
   10 = No odor
   1 = Feces - coyote K (G-AM1-3)

2. At the control post, there was a significant animal-week interaction ($P \leq 0.005$). The variation in these data may be associated with the increased amount of time that coyote K (AM1-3) spent at the control post during week 2 (Fig. 31).

For the "K-I-J Experiment", the analysis of the data on total time at the posts indicates that:

1. At the odor post, the variance component of the "between-odors" main effect (Fig. 32) was significant ($P \leq 0.001$). The RUT shows:

   13 2 4 6 3 1 5 12 10 7 9 11 8

8 = Feces - male domestic dog
11 = Urine - female domestic dog (estrus)
9 = Urine - female domestic dog (anestrus)
7 = Urine - male domestic dog
10 = Feces - female domestic dog (anestrus)
12 = Feces - female domestic dog (estrus)
5 = Urine - coyote J (G-AM3-3)
1 = Urine - coyote K (G-AM1-3)
3 = Urine - coyote I (G-AM2-3)
6 = Feces - coyote J (G-AM3-3)
4 = Feces - coyote I (G-AM2-3)
2 = Feces - coyote K (G-AM1-3)
13 = No odor

2. At the odor post, the variance component of the "between-weeks" main effect (Fig. 33) was significant ($P \leq 0.025$). The RUT shows:

1 12 7 3 13 2 11 15 8 10 5 16 9 14 6 4

3. At the odor post, there was a significant animal-week interaction ($P \leq 0.001$). Coyotes K (AM1-3) and J (AM3-3) exhibited peaks in the total time at the odor post during weeks 4-5, 9-10, and 13-14. Coyote I (AM2-3), however, exhibited peaks during weeks 3-4 and 15-16 (Fig. 33).

4. At the odor post, there was a significant odor-week interaction ($P \leq 0.001$). The data (Fig. 34) suggest that the variation may be associated with urine and feces from domestic dogs. The outstanding peaks in total time at the odor post appear to be associated with the urine from a male domestic dog during weeks 5-8, the feces from a male domestic dog during weeks 15-16, and the urine from a female domestic dog (estrus) during weeks 9-10.

5. At the control post, the variance component of the "between-animals" main effect (Fig. 33) was significant ($P \leq 0.001$). The RUT shows:

I (AM2-3) K (AM1-3) J (AM3-3)

6. At the control post, the variance component of the "between-weeks" main effect (Fig. 33) was significant (P≤0.001). The RUT shows:

```
1
2  12  3  6  7  10  5  9  8  11  16  14  15  4  13
```

For the "M-O-N Experiment", the analysis of the data on total time at the posts indicates that:

1. At the odor post, the variance component of the "between-animals" main effect (Fig. 35) was significant (P≤0.001). The RUT shows:

   O (JF2-3)   M (JM1-3)   N (JF3-3)

2. At the odor post, the variance component of the "between-odors" main effect (Fig. 35) was significant (P≤0.025). The RUT shows:

```
                     4              1
13  9  2  11  5  8  12  3  6  7  10
```

1 = Urine - coyote M (G-JM1-3)
10 = Feces - coyote Q (N-JF2-3)
7 = Urine - coyote P (N-JM1-3)
6 = Feces - coyote N (G-JF3-3)
3 = Urine - coyote O (G-JF2-3)
4 = Feces - coyote O (G-JF2-3)
12 = Feces - coyote S (N-JF3-3)
8 = Feces - coyote P (N-JM1-3)
5 = Urine - coyote N (G-JF3-3)
11 = Urine - coyote S (N-JF3-3)
2 = Feces - coyote M (G-JM1-3)
9 = Urine - coyote Q (N-JF2-3)
13 - No odor

3. At the odor post, the variance component of the "between-weeks" main effect (Fig. 36) was significant (P≤0.001). The RUT shows:

```
12  7  13  6  5  14  11  10  9  4  3  8  2  1
```

4. At the odor post, there was a significant animal-week interaction (P≤0.025). The data (Fig. 36) suggest that the variation

results from the peaks in total time at the odor post that coyotes M (JM1-3) and N (JF3-3) exhibited during week 1 and weeks 8-9, while coyote O (JF2-3) showed a relatively constant decrease in post time as the experiment progressed.

5. At the odor post, there was a significant odor-week interaction ($P \leq 0.05$). The data (Fig. 37) suggest that this variation results from the difference between the greater amount of time spent at the post containing urine from coyote O (G-JF2-3) during weeks 1-2, as compared with the no-odor post.

6. At the control post, the variance component of the "between-animals" main effect (Fig. 36) was significant ($P \leq 0.1$). The RUT shows:

   O (JF2-3) M (JM1-3) N (JF3-3)

7. At the control post, the variance component of the "between-weeks" main effect (Fig. 36) was significant ($P \leq 0.001$). The RUT shows:

   12 11 9 5 13 3 14 10 7 8 6 2 1 4

For the "P-Q-S Experiment", the analysis of the data on total time at the posts indicates that:

1. At the odor post, the variance component of the "between-odors" main effect (Fig. 38) was significant ($P \leq 0.001$). The RUT shows:

   13 3 5 1 8 9 7 2 10 12 4 11 6

   6 = Feces - coyote S (G-JF3-3)
   11 = Urine - coyote N (N-JF3-3)
   4 = Feces - coyote Q (G-JF2-3)
   12 = Feces - coyote N (N-JF3-3)
   10 = Feces - coyote O (N-JF2-3)
   2 = Feces - coyote P (G-JM1-3)

7 = Urine - coyote M (N-JM1-3)
9 = Urine - coyote O (N-JF2-3)
8 = Feces - coyote M (N-JM1-3)
1 = Urine - coyote P (G-JM1-3)
5 = Urine - coyote S (G-JF3-3)
3 = Urine - coyote Q (G-JF2-3)
13 = No odor

2. At the odor post, the variance component of the "between-weeks" main effect (Fig. 39) was significant (P≤0.001). The RUT shows:

16 15 7 12 6 9 11 13 10 14 8 5 4 3 2 1

3. At the odor post, there was a significant animal-week interaction (P≤0.1). The data (Fig. 39) suggest that this variation is the result of the increased amount of time that coyote S (JF3-3) spent at the odor post during week 1.

4. At the odor post, there was a significant odor-week interaction (P≤0.001). The data (Fig. 40) suggest that this variation is the result of the increased amount of time spent at all of the odor posts, except those containing the urine from coyotes P, Q, and S (group coyotes) and the no-odor post during weeks 1-2. There was also an outstanding peak during weeks 1-2 in time spent at the post containing urine from coyote O (N-JF2-3)

5. At the control post, the variance component of the "between-weeks" main effect (Fig. 39) was significant (P≤0.001). The RUT shows:

15 10 16 6 11 12 9 13 8 7 5 14 3 4 2 1

For the "K-I-O-S Experiment", the analysis of the data on total time at the posts indicates that:

1. At the odor post, the variance component of the "between-animals"

main effect (Fig. 41) was significant (P≤0.01). The RUT shows:

I (AM2-4) S (AF4-4) K (AM1-4) O (AF3-4)

2. At the odor post, the variance component of the "between-odors" main effect (Fig. 41) was significant (P≤0.01). The RUT shows:

9 2 3 5 8 1 6 7 4

4 = Feces - coyote P (N-JM2-4)
7 = Urine - coyote N (N-AF4-4)
6 = Feces - coyote Q (N-AF3-4)
1 = Urine - coyote M (N-JM1-4)
8 = Feces - coyote N (N-AF4-4)
5 = Urine - coyote Q (N-AF3-4)
3 = Urine - coyote P (N-JM2-4)
2 = Feces - coyote M (N-JM1-4)
9 = No odor

3. At the odor post, the variance component of the "between-weeks" main effect (Fig. 42) was significant (P≤0.05). The RUT shows:

11 10 12 5 7 9 6 8 3 1 2 4

4. At the control post, the variance component of the "between-animals" main effect (Fig. 41) was significant (P≤0.025). The RUT shows:

I (AM2-4) S (AF4-4) K (AM1-4) O (AF3-4)

5. At the control post, the variance component of the "between-weeks" main effect (Fig. 42) was significant (P≤0.001). The RUT shows:

12 5 9 10 7 11 6 8 2 3 4 1

For the "M-P-Q-N Experiment", the analysis of the data on total time at the posts indicates that:

1. At the odor post, the variance component of the "between-animals" main effect (Fig. 43) was significant (P≤0.001). The RUT shows:

P (JM2-4)   Q (AF3-4)   M (JM1-4)   N (AF4-4)

2. At the odor post, the variance component of the "between-odors" main effect (Fig 43) was significant ($P \leq 0.1$). The RUT shows:

9 3 8 2 5 6 7 4 1

1 = Urine - coyote K (N-AM1-4)
4 = Feces - coyote I (N-AM2-4)
7 = Urine - coyote S (N-AF4-4)
6 = Feces - coyote O (N-AF3-4)
5 = Urine - coyote O (N-AF3-4)
2 = Feces - coyote K (N-AM1-4)
8 = Feces - coyote S (N-AF4-4)
3 = Urine - coyote I (N-AM2-4)
9 = No odor

3. For the odor and control posts combined, the variance component of the "between-odors" main effect (Fig. 43) was significant ($P \leq 0.025$). The RUT shows:

9 3 8 6 5 2 7 4 1

1 = Urine - coyote K (N-AM1-4)
4 = Feces - coyote I (N-AM2-4)
7 = Urine - coyote S (N-AF4-4)
2 = Feces - coyote K (N-AM1-4)
5 = Urine - coyote O (N-AF3-4)
6 = Feces - coyote O (N-AF3-4)
8 = Feces - coyote S (N-AF4-4)
3 = Urine - coyote I (N-AM2-4)
9 = No odor

4. At the odor post, the variance component of the "between-weeks" main effect (Fig. 44) was significant ($P \leq 0.001$). The RUT shows:

2 6 7 5 1 4 3 8

Body Rubbing

Body rubbing that was displayed during the scent experiments was characterized by the animal alternately sniffing, then rubbing the side of its temple, neck, and trunk against a post. Occasionally, the animal

would fall over on its side and wriggle against the object, sometimes turning over onto its back.

The occurrence and duration of body rubbing was recorded during all of the scent experiments. This behavioral pattern was never directed toward anything but the posts, and was displayed only by the adult males (coyotes K, I, and J). The data from each experiment which used these animals were analysed with a three-factor (animal, odor, and week) analysis of variance. Duncan's New Multiple Range Test (P≤0.05) was used to compare the means of the main effects if there was significant variation in the data.

For the "Urine Experiment", the analysis of the data on body rubbing indicates that:

1. At the odor post, the variance component of the "between-animals" main effect was not significant. There was, however, a trend for high-ranking animals to display a greater amount of body rubbing than low-ranking animals (Fig. 45).

2. At the odor post, the variance component of the "between-odors" main effect (Fig. 45) was significant (P≤0.001). The RUT shows:

```
 2
 4
10  3  5  6  1  9  8  7
------------------------
```

 7 = Urine - male domestic dog
 8 = Urine - female domestic dog (anestrus)
 9 = Urine - female domestic dog (estrus)
 1 = Urine - coyote K (G-AM1-3)
 6 = Urine - coyote N (N-PF3-3)
 5 = Urine - coyote O (N-PF2-3)
 3 = Urine - coyote J (G-AM3-3)
 2 = Urine - coyote I (G-AM2-3)
 4 = Urine - coyote M (N-PM1-3)
10 = No odor

3. At the odor post, the variance component of the "between-weeks"

main effect (Fig. 46) was significant (P≤0.001). The RUT shows:

4
6
7
8 3 5 2 1

4. At the odor post, the only significant interaction in the data was between odors and weeks (P≤0.05). The variation in the data (Table 2) may have occurred during week 5, when there appears to have been a selective increase in the amount of body rubbing directed toward the post containing urine from a male domestic dog.

5. At the control post, the variance component of the "between-animals" main effect (Table 3) was significant (P≤0.1). The RUT shows:

J (AM3-3) I (AM2-3) K (AM1-3)

6. At the control post, the variance component of the "between-weeks" main effect (Table 3) was significant (P≤0.025). The RUT shows:

2
6 4
7 8 3 5 1

For the "Feces Experiment", the analysis of the data on body rubbing indicates that:

1. At the odor post, the variance component of the "between-animals" main effect (Fig. 47) was significant (P≤0.025). The RUT shows:

J (AM3-3) I (AM2-3) K (AM1-3)

2. At the odor post, the variance component of the "between-odors" main effect (Fig. 47) was significant (P≤0.1). The RUT shows:

1 3 6
2 5 10 9 4 7 8

Table 2. Total amount of body rubbing that coyotes K, I, and J (adult males) directed toward the odor post, in relation to the various test odors and weeks of the "Urine Experiment", over the period June 22 to August 20, 1970.

Source of Odor (Urine)	Body Rubbing (sec) per Week 1	2	3	4	5	6	7	8	Total
Coyote K (G-AM1-3)	13	4	4	0	0	0	0	0	21
Coyote I (G-AM2-3)	0	0	0	0	0	0	0	0	0
Coyote J (G-AM3-3)	3	0	0	0	2	0	0	0	5
Coyote M (N-PM1-3)	0	0	0	0	0	0	0	0	0
Coyote O (N-PF2-3)	4	0	2	0	0	0	0	0	6
Coyote N (N-PF3-3)	10	0	8	0	0	0	0	0	18
Male domestic dog	80	66	4	0	32	0	0	0	182
Female domestic dog (anestrus)	24	1	0	0	0	0	0	0	25
Female domestic dog (estrus)	21	2	0	0	0	0	0	0	23
No odor	0	0	0	0	0	0	0	0	0
Total	155	73	18	0	34	0	0	0	280

Table 3. Total amount of body rubbing that coyotes K, I, and J (adult males) directed toward the control post, in relation to the week of the "Urine Experiment", over the period June 22 to August 20, 1970.

Coyote	Body Rubbing (sec) per Week								Total
	1	2	3	4	5	6	7	8	
K (AM1-3)	12	1	3	0	4	0	0	1	21
I (AM2-3)	6	0	0	1	0	0	0	0	7
J (AM3-3)	0	0	0	0	0	0	0	0	0
Total	18	1	3	1	4	0	0	1	28

8 = Feces - female domestic dog (anestrus)
7 = Feces - male domestic dog
4 = Feces - coyote M (N-PM1-3)
6 = Feces - coyote N (N-PF3-3)
9 = Feces - female domestic dog (estrus)
3 = Feces - coyote J (G-AM3-3)
10 = No odor
5 = Feces - coyote O (N-PF2-3)
1 = Feces - coyote K (G-AM1-3)
2 = Feces - coyote I (G-AM2-3)

3. At the odor post, the variance component of the "between-weeks" main effect (Fig. 48) was significant (P≤0.01). The RUT shows:

```
4
6   5
7   8   3   2   1
```

4. At the odor post, there was a significant animal-week interaction (P≤0.1). This variation may have resulted from the amount of body rubbing that was exhibited by coyote K (AM1-3) during weeks 2-3 (Table 4).

5. At the control post, the variance component of the "between-animals" main effect (Table 5) was significant (P≤0.1). Only coyote K (AM1-3) rubbed the control post.

6. At the control post, the variance component of the "between-weeks" main effect was significant (P≤0.05). This variation resulted from the amount of body rubbing that was displayed during week 1 (Table 5).

7. At the control post, there was a significant animal-week interaction (P≤0.01). This variation resulted from the amount of rubbing that coyote K (AM1-3) exhibited during week 1 (Table 5).

For the "K-I-J Experiment", the analysis of the data on body rubbing indicates that:

1. At the odor post, the variance component of the "between-animals"

Table 4. Total amount of body rubbing that coyotes K, I, and J (adult males) directed toward the odor post, in relation to the week of the "Feces Experiment", over the period June 23 to August 19, 1970.

Coyote	Body Rubbing (sec) per Week								Total
	1	2	3	4	5	6	7	8	
K (AM1-3)	37	55	20	0	8	0	0	8	128
I (AM2-3)	47	0	0	0	0	0	0	0	47
J (AM3-3)	0	0	0	0	0	0	0	0	0
Total	84	55	20	0	8	0	0	8	175

Table 5. Total amount of body rubbing that coyotes K, I, and J (adult males) directed toward the control post, in relation to the week of the "Feces Experiment", over the period June 23 to August 19, 1970.

Coyote	Body Rubbing (sec) per Week								Total
	1	2	3	4	5	6	7	8	
K (AM1-3)	16	1	0	1	0	0	0	0	18
I (AM2-3)	0	0	0	0	0	0	0	0	0
J (AM3-3)	0	0	0	0	0	0	0	0	0
Total	16	1	0	1	0	0	0	0	18

main effect (Fig. 49) was significant ($P \leq 0.001$). The RUT shows:

J (AM3-3) I (AM2-3) K (AM1-3)

2. At the odor post, the variance component of the "between-odors" main effect (Fig. 49) was significant ($P \leq 0.001$). The RUT shows:

```
          3
13  2  5  6  1  4  10  12  8  9  11  7
```

7 = Urine - male domestic dog
11 = Urine - female domestic dog (estrus)
9 = Urine - female domestic dog (anestrus)
8 = Feces - male domestic dog
12 = Feces - female domestic dog (estrus)
10 = Feces - female domestic dog (anestrus)
4 = Feces - coyote I (G-AM2-3)
1 = Urine - coyote K (G-AM1-3)
3 = Urine - coyote I (G-AM2-3)
6 = Feces - coyote J (G-AM3-3)
5 = Urine - coyote J (G-AM3-3)
2 = Feces - coyote K (G-AM1-3)
13 = No odor

3. At the odor post, the variance component of the "between-weeks" main effect (Fig. 50) was significant ($P \leq 0.001$). The RUT shows:

1 16 15 13 14 11 12 3 4 2 8 10 9 7 6 5

4. At the odor post, there was a significant animal-odor interaction ($P \leq 0.001$). The data (Fig. 49) suggest that the variance results from the amount of rubbing that coyote K (AM1-3) directed toward posts containing urine and feces from domestic dogs, especially the urine samples. Coyotes I (AM2-3) and J (AM3-3) only rubbed the posts containing domestic dog urine.

5. At the odor post, there was a significant animal-week interaction ($P \leq 0.001$). The data (Fig. 50) suggest that the variance may be the result of coyote K (AM1-3) exhibiting a peak in the amount of body rubbing at week 5. Coyotes I (AM2-3) and J (AM3-3), who

rarely rubbed, appeared to peak at week 7.

6. At the odor post, there was a significant odor-week interaction ($P \leq 0.001$). The data (Fig. 51) suggest that the variance may be the result of the late peak in the amount of body rubbing associated with the urine from a female domestic dog in heat.
7. At the control post, the variance component of the "between-animals" main effect was significant ($P \leq 0.05$). Coyote K (AM1-3) displayed more body rubbing (23 seconds) than coyotes I (AM2-3) or J (AM3-3) (0 seconds).

For the "K-I-O-S Experiment", the analysis of the data on body rubbing indicates that:

1. At the odor post, the variance component of the "between-animals" main effect was significant ($P \leq 0.001$). Coyote K (AM1-4) was the only animal to display body rubbing during this experiment (Fig. 52).
2. At the odor post, the variance component of the "between-weeks" main effect was significant ($P \leq 0.001$). The amount of body rubbing exhibited during week 1 was significantly different from the remaining weeks (Fig. 53).
3. At the odor post, there was a significant animal-week interaction ($P \leq 0.001$). This variation resulted from the amount of rubbing that coyote K (AM1-4) exhibited during week 1 (Fig. 53).
4. At the control post, no body rubbing was exhibited during this experiment.

Urination

The urination postures exhibited by the coyotes in this study were

identical to those of the domestic dog (Martins and Valle, 1948).

Newborn puppies of either sex were inconsistent in the urination posture displayed, although there was typically a slight abduction of the legs. At 3 to 5 weeks of age, characteristic postures appeared.

The male coyotes, until 12 to 14 months of age, displayed the infantile male posture of a shallow squat. When mature, the males in this study continued displaying the infantile male posture, occasionally raising one leg underneath the body. The typical "crooked leg" of a mature male was rarely seen, but this was expected since the odor source was a horizontal object (Kleiman, 1966). The pattern of juvenile and adult females was the same, consisting of a deep squat.

Micturition during the scent experiments was exhibited primarily by coyotes K, I, and J (adult males). These animals were also the only ones to direct urine onto either of the posts (Table 6). Because of this, only the data on the frequency of urination exhibited by coyotes K, I, and J were statistically analysed. The analysis was made with a three-factor (animal, odor, and week) analysis of variance, following a square-root transformation of the data. Duncan's New Multiple Range Test ($P \leq 0.05$) was used to compare the means of the main effects if there was significant variation in the data.

For the "Urine Experiment", the analysis of the data on the frequency of urination indicates that:

1. At the odor post, the variance component of the "between-weeks" main effect (Figs. 55, 57, and 59) was significant ($P \leq 0.05$).

   The RUT shows:

   6
   2 1 4 5 7 8 3

Table 6. Urination frequency exhibited by the study animals during the various scent experiments.

Experiment	Coyote	Urination Frequency				
		Odor Post	Control Post	Drain	Misc.	Total
	K (AM1-3)	19	12	0	2	33
Urine	I (AM2-3)	14	8	4	0	26
(R=80)*	J (AM3-3)	14	15	23	0	52
	K (AM1-3)	34	16	0	1	51
Feces	I (AM2-3)	20	5	4	1	30
(R=80)	J (AM3-3)	20	10	20	0	50
	K (AM1-3)	44	27	0	0	71
K-I-J	I (AM2-3)	38	5	0	0	43
(R=208)	J (AM3-3)	29	28	13	0	70
	M (JM1-3)	0	0	0	0	0
M-O-N	O (JF2-3)	0	0	0	3	3
(R=182)	N (JF3-3)	0	0	0	0	0
	P (JM1-3)	0	0	0	3	3
P-Q-S	Q (JF2-3)	0	0	0	0	0
(R=208)	S (JF3-3)	0	0	0	1	1
	K (AM1-4)	42	32	1	2	77
K-I-O-S	I (AM2-4)	13	2	0	1	16
(R=108)	O (AF3-4)	0	0	0	0	0
	S (AF4-4)	0	0	0	0	0
	M (JM1-4)	0	0	0	0	0
M-P-Q-N	P (JM2-4)	0	0	0	0	0
(R=72)	Q (AF3-4)	0	0	0	0	0
	N (AF4-4)	0	0	0	0	0

* R = number of tests per animal

2. At the odor post, there was a significant animal-week interaction ($P \leq 0.05$). The variation in these data appears to result from the increased frequency of urination exhibited by coyote K (AM1-3) at the end of the experiment (Fig. 55). Coyotes I (AM2-3) and J (AM3-3) displayed the greatest frequency of urination during week 3 (Figs. 57 and 59, respectively).

3. At the control post, the variance component of the "between-weeks" main effect (Figs. 55, 57, and 59) was significant ($P \leq 0.025$). The RUT shows:

   5   2
   8   1   3   6   4   7

4. At the control post, there was a significant animal-week interaction ($P \leq 0.025$). The variation in these data appears to result from the increased frequency of urination exhibited by coyote K (AM1-3) during week 7 (Fig. 55). Coyotes I (AM2-3) and J (AM3-3) displayed the greatest frequency of urination during the early weeks of the experiment (Figs. 57 and 59, respectively).

5. At the drain, the variance component of the "between-animals" main effect (Table 6) was significant ($P \leq 0.001$). The RUT shows:

   K (AM1-3)   I (AM2-3)   J (AM3-3)

6. At the drain, there was a significant animal-week interaction ($P \leq 0.005$). The variation in these data (Figs. 55, 57, and 59) may have resulted from the high frequency of urination exhibited by coyote J (AM3-3) during weeks 1-2 (Fig. 59).

7. For the total frequency of urination, the variance component of the "between-animals" main effect (Table 6) was significant ($P \leq 0.01$). The RUT shows:

I (AM2-3)   K (AM1-3)   J (AM3-3)

8. For the total frequency of urination, there was a significant animal-week interaction (P≤0.01). The variation in these data appears to result from the increased frequency of urination exhibited by coyote K (AM1-3) at the end of the experiment (Fig. 55). Coyotes I (AM2-3) and J (AM3-3) displayed the greatest frequency of urination during the early weeks of the experiment (Figs. 57 and 59, respectively).

For the "Feces Experiment", the analysis of the data on the frequency of urination indicates that:

1. At the odor post, the variance component of the "between-animals" main effect (Table 6) was significant (P≤0.025). The RUT shows:

   I (AM2-3)
   J (AM3-3)   K (AM1-3)

2. At the odor post, the variance component of the "between-weeks" main effect (Figs. 61, 63, and 65) was significant (P≤0.005). The RUT shows:

   1 2 3 5 4 7 6 8

3. At the odor post, there was a significant animal-week interaction (P≤0.005). The variation in these data appears to result from the high urination frequency exhibited by coyote K (AM1-3) during weeks 6-8 (Fig. 61). Coyote J (AM3-3) (Fig. 65) exhibited the greatest urination frequency during week 3, while coyote I (AM2-3) (Fig. 63) peaked during weeks 4 and 8.

4. At the control post, the variance component of the "between-animals" main effect (Table 6) was significant (P≤0.05). The RUT shows:

I (AM2-3) J (AM3-3) K (AM1-3)

5. At the control post, the variance component of the "between-weeks" main effect (Figs. 61, 63, and 65) was significant (P≤0.025). The RUT shows:

```
        2  3  4
1   5   7  8  6
```

6. At the control post, there was a significant animal-week interaction (P≤0.1). The variation in these data appears to result from the high urination frequency exhibited by coyote K (AM1-3) (Fig. 61) during week 6. Coyotes I (AM2-3) and J (AM3-3) (Figs. 63 and 65, respectively) displayed the greatest frequency of urination during week 3.

7. At the drain, the variance component of the "between-animals" main effect (Table 6) was significant (P≤0.001). The RUT shows: K (AM1-3) I (AM2-3) J (AM3-3)

8. At the drain, the variance component of the "between-weeks" main effect (Figs. 61, 63, and 65) was significant (P≤0.01). The RUT shows:

```
    4
    5  3
8   7  6  1  2
```

9. At the drain, there was a significant animal-week interaction (P≤0.001). The variation in these data (Figs. 61, 63, and 65) may have resulted from the high frequency of urinations exhibited by coyote J (AM3-3) during weeks 1-2 (Fig. 65).

10. For the total frequency of urination, the variance component of the "between-animal" main effect (Table 6) was significant (P≤0.025).

The RUT shows:

I (AM2-3)   J (AM3-3)   K (AM1-3)

11. For the total frequency of urination, the variance component of the "between-weeks" main effect (Figs. 61, 63, and 65) was significant ($P \leq 0.025$). The RUT shows:

1 2 5 7 4 8 3 6

12. For the total frequency of urination, there was a significant animal-week interaction ($P \leq 0.001$). The variation in these data appears to result from the high frequency of urination exhibited by coyote K (AM1-3) (Fig. 61) during week 6. Coyotes I (AM2-3) and J (AM3-3) (Figs. 63 and 65, respectively) both exhibited a high frequency of urination during week 3.

For the "K-I-J Experiment", the analysis of the data on the frequency of urination indicates that:

1. At the odor post, the variance component of the "between-odors" main effect (Figs. 66, 68, and 70) was significant ($P \leq 0.005$). The RUT shows:

2 7 13 11 5 9 4 1 12 10 3 6 8

8 = Feces - male domestic dog
6 = Feces - coyote J (G-AM3-3)
3 = Urine - coyote I (G-AM2-3)
10 = Feces - female domestic dog (anestrus)
12 = Feces - female domestic dog (estrus)
1 = Urine - coyote K (G-AM1-3)
4 = Feces - coyote I (G-AM2-3)
9 = Urine - female domestic dog (anestrus)
5 = Urine - coyote J (G-AM3-3)
11 = Urine - female domestic dog (estrus)
13 = No odor
7 = Urine - male domestic dog
2 = Feces - coyote K (G-AM1-3)

2. At the odor post, the variance component of the "between-weeks"

main effect (Figs. 67, 69, and 71) was significant (P≤0.001).

The RUT shows:

```
3           2       1        10
5   7   6   8   4   9   12   11   13   14   15   16
```

3. At the odor post, there was a significant animal-week interaction (P≤0.1). The variation in these data appears to be associated with week 15, when coyote J (AM3-3) displayed only 1 urination pattern (Fig. 71), while coyotes K (AM1-3) and I (AM2-3) were urinating frequently (Figs. 67 and 69, respectively).

4. At the control post, the variance component of the "between-animals" main effect (Table 6) was significant (P≤0.001). The RUT shows:

   I (AM2-3)   K (AM1-3)   J (AM3-3)

5. At the control post, the variance component of the "between-weeks" main effect (Figs. 67, 69, and 71) was significant (P≤0.001). The RUT shows:

```
 3    2
 5    4
 6    8
 7    9   11
10   12   14   1   13   16   15
```

6. At the control post, there was a significant animal-week interaction (P≤0.001). The variation in these data appears to result from the lack of any urination patterns by coyote I (AM2-3) during week 15 (Fig. 69). Both coyotes K (AM1-3) and J (AM3-3) displayed a high urination frequency during this week (Figs. 67 and 71, respectively).

7. At the drain, the variance component of the "between-animals"

main effect was significant (P≤0.001). Only coyote J (AM3-3) urinated on the drain during this experiment (Table 6).

8. At the drain, the variance component of the "between-weeks" main effect was significant (P≤0.01). Week 13 of the experiment was associated with more urination patterns than any of the other weeks (Fig. 71).

9. At the drain, there was a significant animal-week interaction (P≤0.001). The variation in these data appears to result from the high frequency of urination exhibited by coyote J (AM3-3) during week 13 (Fig. 71).

10. For the total frequency of urination, the variance component of the "between-animals" main effect (Table 6) was significant (P≤0.025). The RUT shows:

    I (AM2-3)   J (AM3-3)   K (AM1-3)

11. For the total frequency of urination, the variance component of the "between-weeks" main effect (Figs. 67, 69, and 71) was significant (P≤0.001). The RUT shows:

```
3                 2
5   7   6   8   4   9   10   12   1   11   14   13   16   15
```

12. For the total frequency of urination, there was a significant animal-week interaction (P≤0.025). The variation in these data appears to result from the low frequency of urination displayed by coyote I (AM2-3) during weeks 13-14 (Fig. 69). During weeks 13-14, both coyotes K (AM1-3) and J (AM3-3) exhibited a high urination frequency (Fig. 67 and 71, respectively).

For the "K-I-O-S Experiment", the analysis of the data on the frequency

of urination exhibited by coyotes K and I indicates that:

1. At the odor post and the control post, the variance component of the "between-animals" main effect was significant (P≤0.001). Coyote K (AM1-4) displayed more urination patterns than coyote I (AM2-4) (Table 6).

2. At the control post, the variance component of the "between-weeks" main effect (Figs. 73 and 75) was significant (P≤0.025). The RUT shows:

```
         6
5    7   8
9   12  10   1   11   2   3   4
```

3. At the control post, there was a significant animal-week interaction (P≤0.005). The variation in these data appears to result from the high frequency of urination exhibited by coyote K (AM1-4) during weeks 1-4 (Fig. 73). The 2 times that coyote I (AM2-4) urinated on the control post occurred during weeks 8 and 10 (Fig. 75).

4. For the total frequency of urination, the variance component of the "between-animals" main effect was significant (P≤0.001). Coyote K (AM1-4) displayed more urination patterns than coyote I (AM2-4) (Table 6).

Defecation

The defecation patterns of all the coyotes used in this study were identical. The posture was characterized by a deep squat, tail root raised, and back slightly hunched.

The data on the occurrence of a defecation pattern were analysed for the animals in the various scent experiments where the pattern was

displayed (Table 7). Cochran's Q-Test was used to determine if there was any association between the test odor and the display of a defecation pattern. A runs test for dichotomized data ($P \leq 0.05$) was made to determine if the animals defecated in a random fashion over the weeks of the experiments. Fisher's Exact Test was used to test for differences in the defecation frequency between animals.

For the "Feces Experiment", the analysis of the data on the frequency of defecation indicates that:

1. The data for the "between-weeks" analysis were insufficient to demonstrate any trends in the defecation frequency for coyotes I (AM2-3) and J (AM3-3) (Figs. 63 and 65, respectively). Coyote K (AM1-3), however, exhibited an increase in the occurrence of defecation toward the end of the experiment (Fig. 61).

For the "K-I-J Experiment", the analysis of the data on the frequency of defecation indicates that:

1. Coyote J (AM3-3) displayed more defecation patterns than coyote I (AM2-3) ($P \leq 0.07$). Coyote K (AM1-3) was statistically similar to coyotes I and J in the defecation frequency (Table 7).
2. Coyotes K, I, and J (Figs. 67, 69, and 71, respectively) all exhibited randomness in the occurrence of defecation patterns, in relation to the week of the experiment.

For the "P-Q-S Experiment", the analysis of the data on the frequency of defecation indicates that:

1. Coyote P (JM1-3) displayed more defecation patterns than coyote S (JF3-3) ($P \leq 0.04$). Coyote Q (JF2-3) was statistically similar to coyotes P and S in the defecation frequency (Table 7).
2. Coyote P (JM1-3) exhibited non-randomness in the occurrence of

Table 7. Defecation frequency exhibited by the study animals during the various scent experiments.

		Defecation Frequency			
Experiment	Coyote	Odor Post	Control Post	Misc.	Total
	K (AM1-3)	1	1	5	7
Urine	I (AM2-3)	0	2	9	11
(R=80)*	J (AM3-3)	0	0	9	9
	K (AM1-3)	1	0	4	5
Feces	I (AM2-3)	0	0	7	7
(R=80)	J (AM3-3)	0	0	8	8
	K (AM1-3)	0	1	5	6
K-I-J	I (AM2-3)	0	0	4	4
(R=208)	J (AM3-3)	0	0	14	14
	M (JM1-3)	0	0	0	0
M-O-N	O (JF2-3)	0	0	0	0
(R=182)	N (JF3-3)	0	0	0	0
	P (JM1-3)	0	0	14	14
P-Q-S	Q (JF2-3)	0	0	2	2
(R=208)	S (JF3-3)	0	0	1	1
	K (AM1-4)	3	1	19	23
K-I-O-S	I (AM2-4)	2	0	6	8
(R=108)	O (AF3-4)	0	0	0	0
	S (AF4-4)	0	0	0	0
	M (JM1-4)	0	0	0	0
M-P-Q-N	P (JM2-4)	0	0	5	5
(R=72)	Q (AF3-4)	0	0	0	0
	N (AF4-4)	0	0	0	0

* R - number of tests per animal

defecation patterns, in relation to the week of the experiment (Table 8). This deviation from randomness probably occurred during weeks 6-11, when a pattern was displayed every week. Coyote Q (JF2-3) exhibited randomness in its defecation frequency. Coyote S (JF3-3) defecated only once, so no trends could be tested for.

For the "K-I-O-S Experiment", the analysis of the data on the frequency of defecation indicates that:

1. Coyote K (AM1-4) exhibited more defecation patterns ($P \leq 0.005$) than coyote I (AM2-4) (Table 7). Coyote I exhibited more defecation patterns than coyotes O (AF3-4) and S (AF4-4) ($P \leq 0.04$). Coyotes O and S never defecated during this experiment.
2. Coyote K (AM1-4) defecated during every week of this experiment (Fig. 73). Coyote I (AM2-4) exhibited non-randomness in the occurrence of a defecation pattern by defecating during the last 5 weeks of the experiment (Fig. 75).

For the "M-P-Q-N Experiment", the analysis of the data on the frequency of defecation indicates that:

1. Coyote P (JM2-4) exhibited more defecation patterns ($P \leq 0.03$) than coyotes M (JM1-4), Q (AF3-4), and N (AF4-4) (Table 7). Coyotes M, Q, and N never defecated during this experiment.
2. Coyote P (JM2-4) displayed randomness in the occurrence of defecation patterns, in relation to the week of the experiment (Table 8).

Defecation patterns that were directed toward either the odor post or the control post were only exhibited by coyotes K and I, both adult males (Table 9). There are no significant differences in these data, although there was a trend for coyote K to defecate on a post more than coyote I did. There was also a trend for more defecation patterns to be

Table 8. Relationship between the week of the experiment and the occurrence of a defecation pattern (occurrence = 1) exhibited by coyotes other than K, I, and J.

		Week																
Experiment	Coyote	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total
P-Q-S	P (JM1-3)	0	0	0	0	0	1	1	1	1	1	1	0	0	0	1	0	7
	Q (JF2-3)	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	2
	S (JF3-3)	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
M-P-Q-N	P (JM2-4)	0	1	0	1	1	1	1	0									5

Table 9. Relationship between the test odor and the defecation patterns that coyotes K and I directed toward the posts during the various scent experiments.

Experiment	Test Odor	Coyote K		Coyote I	
		Odor Post	Control Post	Odor Post	Control Post
Urine	Urine - coyote J (G-AM3-3)				X
	Urine - coyote M (N-PM1-3)	X			
	Urine - male dog		X		X
Feces	Feces - coyote O (N-PF2-3)	X			
K-I-J	Urine - anestrus dog		X		
K-I-O-S	Urine - coyote M (N-JM1-4)	X			
	Urine - coyote P (N-JM2-4)		X	X	
	Urine - coyote N (N-AF4-4)	X		X	
	Feces - coyote N (N-AF4-4)	X			

associated with urine odors than with fecal odors.

DISCUSSION

The use of eliminations from domestic dogs warrants some explanation before commencing the discussion.

Eliminations from domestic dogs were used to test for possible seasonal variation in the responses of coyotes to odors without a seasonal component (see "Discussion of Aims"). Some caution, however, must be exercised when attempting to interpret response differences to coyote and dog scents, since dog odors may convey meanings not present in coyote odors (e.g. oddity of a different species). The novelty of the dog odors must also be considered, since the eliminations were obtained from a different animal each week. However, the various dog odors should all convey the "different meaning", so comparisons may be made within the dog odor category.

This study was not designed to determine how coyotes respond to odors from domestic dogs, but rather to determine if coyotes respond in a cyclic and differential manner to various types of elimination.

This discussion will be restricted to those data that are directly applicable to the original questions this study was designed to answer (see p. 4). The volume of the data prohibits a more detailed analysis at this time.

General Behavior

The general behavior parameters recorded during this study were the total time spent near and at the experimental posts, general activity, and olfactory exploration of the room. These parameters were recorded during all of the scent experiments.

The total time spent in the side of the room containing the odor post was recorded to determine if any overt approach or avoidance reactions were elicited by the test odors. No significant differences were demonstrated, suggesting that an equal amount of time was spent in both sides of the room, and that any increase in time spent performing one kind of behavior (primary effect) may result in a time decrease in other behaviors (secondary effects). The possibility that a secondary effect could be misinterpreted as a primary effect was considered during this analysis.

A relationship between general activity and the test odors was exhibited only during the "K-I-J and M-P-Q-N Experiments". In the "K-I-J Experiment", the variance component of the "between-odors" main effect was significant for the control side of the room ($P \leq 0.1$), and for the total room ($P \leq 0.05$), but not for the odor side. The greater variation in the data for the total room suggests the variation for each side are additive, so this discussion will be restricted to the data for the total room. These data suggest that there was increased activity associated with the fecal odors, and/or decreased activity associated with urine odors, especially domestic dog urine. These differences, however, may have resulted from less time being available for general activity. If much time was spent at the posts, less time would be available for the animal to be active. This does not appear to be the case, since differences in activity were not exhibited in experiments in which a greater or equal amount of time was spent at the posts. Also, the fecal samples from domestic dogs were associated with both increased activity and increased time at the posts. The differences in the data are probably associated with increased activity when exposed to fecal odors. The low level of activity associated with the no-odor tests supports this conclusion.

If increased activity indicates increased "restlessness", then the adult male coyotes appeared to become "restless" when exposed to fecal odors during the "K-I-J Experiment" (autumn to mid-winter). Since these animals did not exhibit an association between activity and odors during any other time of the year, this seasonal increase suggests a change in either the motivation of the animals, or in the fecal odors, or both. Probably, both were involved. The animals may have been motivated toward aggression, since increases in activity may be associated with a decrease in threshold for aggressive behavior, as Archer (1968) suggests may occur in mice, *Mus musculus*. Also, androgens increase readiness of mice to engage in aggressive acts (Beeman, 1947), and the androgen level in male coyotes probably increases until mid-winter (see p. 81). The odor of the feces may also have changed, since the anal glands, which may impart an odor to feces (Hesterman and Mykytowycz, 1968; Scott and Fuller, 1965), may increase in size and secretory activity when the androgen level is increased, as has been shown in lagomorphs (Mykytowycz, 1966). However, the changing motivation may contribute more to the differences in the data than the changing odors do, because during the "Urine and Feces Experiments" in the summer, no activity-odor differences were detected using fecal samples from sexually mature dogs.

In the "M-P-Q-N Experiment", the variance component of the "between-odors" main effect was significant for the control side of the room ($P \leq 0.01$), and for the total room ($P \leq 0.025$), but not for the odor side. The greater variation in the data for the control side suggests the differences for the total room resulted from the differences on the

control side, so this discussion will be restricted to the data from the control side. These data suggest that increased activity was associated with the feces of coyote K, a dominant adult male. This greater activity appears to be an increase, not just a shift between sides, since a compensatory decrease in activity was not exhibited on the odor side of the room. These data, then, suggest that when juvenile males and adult females were exposed to the fecal odor of a dominant adult male, their activity increased in the opposite side of the room. This could indicate an avoidance reaction. If, as Skirrow (1969) suggests, an animal avoids a scent post by retreating to an area of lower marking frequency, an exclusive area may be maintained. Since coyotes are slightly gregarious in winter (Ozoga and Harger, 1966), and this experiment was run in the spring, an avoidance reaction to a dominant, adult male's feces could function as a dispersal mechanism.

A relationship between the test odors and olfactory exploration of the room was exhibited only during the "K-I-O-S Experiment". The variance component of the "between-odors" main effect was significant ($P \leq 0.05$), resulting from an increased amount of room exploration associated with the no-odor post on the odor side of the room. This difference may have occurred by chance, since an increase in exploration was not shown on the control side of the room. Therefore, the amount of olfactory exploration of the room does not appear to be associated with the test odors in any of the experiments. Since the test odors included a control (no odor), this lack of differences in room exploration suggests that the coyotes did not develop an odor "expectation". These data also indicate that none of the odors motivated the coyotes to exhibit fear-induced exploration (Halliday, 1966), suggesting that "fear" of the odors, if any, is

minimal.

During the "Urine Experiment", there was a significant animal-odor interaction ($P \leq 0.025$), and a significant odor-week interaction ($P \leq 0.01$), in the total time spent at the odor posts. Neither of these interactions were significant in the "Feces Experiment", suggesting less variation between test animals, and between weeks in the response to fecal odors than to urine odors. Korytin (1970) reported that the common fox (*Vulpes vulpes*), blue fox (*Alopex beringensis*), and domestic dog exhibit less variability in the reaction to biological odors (mink's musk and meat decomposition products) than to indifferent odors (anise oil and valerian oil). This suggests that in this experimental situation, specific fecal odors may have a general importance to all of the test animals, while specific urine odors may be important to individual animals.

In both the "Urine and Feces Experiment", the variance component of the "between-odors" main effect was significant ($P \leq 0.001$) for the total time spent at the odor post. Since these experiments were identical except for the kind of elimination, the data for the test odors from both experiments will be analysed together, rather than considering them as two separate experiments. When the data were analysed with Duncan's New Multiple Range Test ($P \leq 0.05$), the differences in the data (Table 10) suggest that most time was spent with the feces from a female domestic dog (anestrus). The urine from a male domestic dog received the second greatest amount of attention. Beyond this, the remaining elimination samples from the domestic dogs, and feces in general, all received more attention than coyote urine.

During the "K-I-J Experiment", most time was spent at the post containing feces from a male domestic dog, followed by urine from female

Table 10. Differences between odors in the total time that coyotes K, I, and J (adult males) spent at the test odors used in the "Urine and Feces Experiments" (combined analysis), over the period June 22 to August 20, 1970. Any two values not included with the same vertical line are significantly different ($P \leq 0.05$).

Test Odor	Mean Time (sec) At Odor Post
Feces - Female Domestic Dog (anestrus)	62.8
Urine - Male Domestic Dog	41.5
Urine - Female Domestic Dog (anestrus)	32.8
Feces - Male Domestic Dog	31.9
Urine - Female Domestic Dog (estrus)	24.6
Feces - Coyote N (N-PF3-3)	24.2
Feces - Female Domestic Dog (estrus)	22.1
Feces - Coyote O (N-PF2-3)	21.4
Feces - Coyote M (N-PM1-3)	18.8
Feces - Coyote J (G-AM3-3)	15.7
Urine - Coyote M (N-PM1-3)	13.9
Feces - Coyote I (G-AM2-3)	13.0
Urine - Coyote O (N-PF2-3)	12.7
No Odor - (Feces Exp.)	12.3
Urine - Coyote I (G-AM2-3)	11.7
Urine - Coyote K (G-AM1-3)	11.5
Feces - Coyote K (G-AM1-3)	11.0
Urine - Coyote N (N-PF3-3)	10.8
No Odor - (Urine Exp.)	9.7
Urine - Coyote J (G-AM3-3)	9.4

(estrus and anestrus) domestic dogs. All domestic dog samples received more attention than samples taken from the test group. There was also a significant odor-week interaction ($P \leq 0.001$) during this experiment, probably resulting from the increased time spent at the feces from a male domestic dog, and at the urine from a female domestic dog (estrus), toward the end of the experiment (Fig. 34).

The data from those experiments in which eliminations from domestic dogs were used ("Urine, Feces, and K-I-J Experiments") suggest that during the summer ("Urine and Feces Experiments"), the adult males were most "interested" in the feces from an anestrus female, followed by the urine from a male. As the breeding season approached (late "K-I-J Experiment"), this "interest" appeared to shift to the feces from a male, and the urine from an estrus female. The response to estrus urine was expected, since this has been demonstrated with domestic dogs (Beach and Gilmore, 1949). The "interest" in anestrus female feces during the summer may be associated with finding a mate, because the coyote "family" which travels together in winter breaks up in spring (Murie, 1940), at which time lone males may seek a mate, since coyotes normally travel in pairs (Wolfram, 1964). The apparent change of "interest" in male elimination from urine in summer to feces in winter may be associated with a changing fecal odor (see p. 73).

For the total time spent at the odor post during both the "M-O-N and P-Q-S Experiments", the variance component of the "between-odors" main effect was significant ($P \leq 0.025$ and 0.001, respectively). Since the experiments were designed as mirror-images of each other, and no animal-odor interaction was shown in either experiment, the data from both experiments on total time spent at the odor post during weeks 1-14 (R=14 for M-O-N and 16 for P-Q-S) were combined. The data were combined on the

basis of the response toward the odors from individual animals, rather than on a group versus non-group basis. For a discussion of the reason for this procedure, refer to "Individual Recognition by Urine and Fecal Odors".

The data from the combined analysis of the "M-O-N and P-Q-S Experiments" (Table 11) suggests that most "interest" was associated with female feces. The responses to fecal odors in general appear to show less variability than the responses to urine odors. Similar results were previously discussed in connection with the "Urine and Feces Experiments" (see p. 75).

In the "K-I-O-S Experiment", the variance component of the "between-odors" main effect was significant ($P \leq 0.01$) for the total time spent at the odor post. There was no significant animal-odor, or odor-week interaction. The greatest amount of time was spent at the post containing the feces from coyote P (N-JM2-4). Although there was no significant animal-odor interaction, Fig. 41 indicates that coyotes O (AF3-4) and S (AF4-4) spent more time at the fecal odor from coyote P than coyotes K (AM1-4) and I (AM2-4) did. This suggests that, in the spring, adult females may be "interested" in juvenile males that are close to them in social status.

In the "M-P-Q-N Experiment", the variance component of the "between-odors" main effect was significant for the total time spent at the odor post ($P \leq 0.1$), and for the total time spent at both posts ($P \leq 0.025$), but not for the control post. The greater variation in the data for both posts suggests the variation for each post are additive, so this discussion will be restricted to the data on the total time spent at both posts combined. There was no animal-odor, or odor-week interaction during this experiment. The greatest amount of time was spent at the posts when

Table 11. Differences between odors in the total time that coyotes M, O, N, P, Q, and S spent at the test odors used in the "M-O-N and P-Q-S Experiments" (combined analysis), over the period September 15, 1970 to February 3, 1971. Any two times not included with the same vertical line are significantly different (P≤0.05).

Test Odor: Male Urine	Male Feces	Female Urine	Female Feces	Mean Time (sec) At Post
			S-3*	16.8
			Q-2	15.7
			N-3	15.5
			O-2	14.8
M-1				14.6
		N-3		14.5
		O-2		14.1
	P-1			14.0
P-1				12.7
	M-1			11.1
		S-3		10.9
		Q-2		9.8
				6.2**

* Letter = coyote that contributed test odor
Number = rank of coyote within own group

** No odor

the test odor was urine from coyote K (N-AM1-4), while the least amount of time was associated with the urine from coyote I (N-AM2-4) (Fig. 43). In other words, in the spring, both juvenile males and adult females were more "interested" in urine from a dominant adult male than in urine from a subordinate adult male. Since these animals displayed increased activity away from (avoided) the feces of the same dominant adult male (see p. 74), it may be that odors from urine and feces of a specific animal convey two different meanings. However, the time spent at the odor may have been, at least in part, fear-induced exploration (Halliday, 1966), which would suggest similar meanings in urine and feces, but more intense in feces.

Possible Scent Marking and Related Behavior

Scent marking in the family Canidae has been defined by Kleiman (1966, p. 167) as "urination, defecation, or rubbing of certain areas of the body which is (1) oriented to specific objects, (2) elicited by familiar conspicuous landmarks and novel objects or odors, and (3) repeated frequently on the same object". This discussion will be limited to coyotes K, I, and J (adult males), as they were the only ones that displayed scent marking, according to Kleiman's criteria.

In addition to body rubbing, urination, and defecation, the behavioral patterns of scratching the substrate after elimination and dragging the anal region will also be considered. These patterns may be involved in, or at least related to, scent marking in canids.

Body Rubbing

Body rubbing is a well known behavioral pattern in canids (Mech, 1970; Van Wormer, 1964). Kleiman (1966) believes that it is a method of scent

marking, although, as she states, most authors do not. Van Wormer (1964) states that coyotes "like" to roll on strong odors, while Fuller and Du Buis (1962) report that dogs occasionally roll on exotic odors, but more often urinate on or near them.

During this study, there was a positive correlation between the amount of body rubbing displayed and the social status of the adult males. Since Ralls (1971) states that dominant individuals tend to exhibit the greatest frequency of marking, this supports Kleiman's (1966) opinion that body rubbing is a method of scent marking. However, Ewer (1968) states that mammals which scent mark by rubbing have specialized glands for the deposition of scent, and Hildebrand (1952) reports that members of the family Canidae do not have scent glands on the trunk of their bodies. This suggests that body rubbing may not be involved in scent marking, contrary to the opinion of Kleiman (1966). This contradiction in the possible functional significance of body rubbing may be resolved by examining the temporal distribution of this pattern, since marking behavior in the male Mongolian gerbil (*Meriones unguiculatus*) is androgen dependent (Thiessen, Friend, and Lindzey, 1968), and coyotes exhibit a sexual cycle (Hamlett, 1938) which should be accompanied by a testosterone cycle.

The reproductive cycle of male coyotes is characterized by changes in the size of the testes, and in the amount of spermatogonial activity (Hamlett, 1938). Hamlett states that the testes show the greatest size and activity during the breeding season in late February, after which they regress, reaching their lowest level of activity in October. There may be a difference of a month between animals in the timing of this cycle. He does not comment on the activity of the interstitial cells, the source of androgen (Hoar, 1966), but it seems probable that the activity of these

cells would coincide with the testicular cycle.

During the "Urine and Feces Experiments", there was much rubbing displayed during the first 2 weeks, but little rubbing in the latter part of the experiments (Figs. 46 and 48, respectively). A small peak of rubbing was also observed during the first week of the "K-I-O-S Experiment" (Fig. 53). However, during the "K-I-J Experiment", coyote K (AM1-3) displayed a peak in body rubbing during week 5 (late October), while coyotes I (AM2-3) and J (AM3-3) peaked during week 7 (mid-November) (Fig. 50).

The temporal delay in the peaks of body rubbing during the "K-I-J Experiment" suggests a relationship between body rubbing and the androgen cycle previously discussed. This possibility is supported by the greater amount of rubbing exhibited by the higher ranking males, since males that are high in social status may also have high levels of testosterone (Ralls, 1971). The amount of rubbing, however, does not appear to be directly correlated with the amount of testosterone since little rubbing occurred near the breeding season. Perhaps a critical level of testosterone is required before adult males find certain odors "interesting" enough to rub. Weekly exposures to "interesting" odors appear to result in a response decrement (Figs. 46, 48, and 50).

The odors that were rubbed were primarily those from domestic dogs. A combined analysis of the "Urine and Feces Experiments" (see p. 75) was run using Duncan's New Multiple Range Test ($P \leq 0.05$). The only significant difference in these data was the greater amount of body rubbing associated with urine from male domestic dogs. During the "K-I-J Experiment", most rubbing was again associated with urine from male domestic dogs, followed by female urine (estrus and anestrus). The response toward the estrus urine occurred later in the experiment (Fig. 51), suggesting that males

would be close to maturity before they find estrus urine "interesting" enough to rub. Again, weekly exposures resulted in a response decrement.

In this experimental situation then, body rubbing appeared to be a behavioral pattern that was exhibited mainly by high-ranking adult males that were approaching, or at sexual maturity. This response appeared to be directed primarily toward urine odors, expecially those from male domestic dogs. Since the domestic dog urine and feces were obtained from a different animal every week, and since weekly exposures to the odors were sufficient to "familiarize" the animals with the odors, something other than novelty at the individual level appears to be involved. The body rubbing these animals displayed may have been motivated by a novel odor from a different species, and functioned to receive the odor, not to place one. This possibility is supported by the temporal distribution of body rubbing. During the "K-I-J Experiment", the adult males displayed the greatest amount of body rubbing at a time when urination, an acknowledged marking pattern (Kleiman, 1966), was rarely displayed (Figs. 67, 69, and 71). This was also clearly exhibited by coyote K (AM1-3) during the "Urine Experiment" (Figs. 46 and 55) and the "Feces Experiment" (Figs. 48 and 61).

Urination

The use of urine by canids as a scent marking substance has been described by several authors (Ewer, 1968; Kleiman, 1966; Scott and Fuller, 1965). During this study, only the adult males (coyotes K, I, and J) exhibited micturition patterns which could be classed as scent

marking. Female coyotes, according to Kleiman (1966), scent mark during the breeding season. This, however, never occurred in the observation room, although coyote E, the female parent of the study animals (Fig. 1) did scent mark in an outdoor enclosure during estrus.

The frequency and site of urine marking may be associated with social rank (Table 6). During the experiments which used all three adult males ("Urine, Feces, and K-I-J Experiments"), coyote K (AM1-3) urinated on the odor post more than coyotes I (AM2-3) and J (AM3-3) did (Table 6), although the differences were significant ($P \leq 0.025$) only during the "Feces Experiment". At the control post, coyotes K and J both displayed a similar frequency of urination, and both urinated more than coyote I. Coyote J urinated on the drain more frequently than either of the other animals. Thus, for the total frequency of urination, the subordinate male (coyote J) urinated as frequently, or more frequently than the dominant male (coyote K), while the male of intermediate rank (coyote I) urinated the least. This appears to contradict the opinions of authors such as Ewer (1968) and Ralls (1971), who suggest that the dominant animal marks the most, and the subordinate animal the least. However, the crucial point appears to be the urination site, not the frequency of urination per se. The dominant male directed 62.6% of its urinations toward the odor post, while the subordinate male urinated on the odor post only 36.6% of the time. The 63.4% of the subordinate male's urinations that were not directed toward the odor post were directed toward either the control post (30.8%) or the drain (32.6%). Thus, the subordinate male appears to urinate on three sites (odor post, control post, and drain) in a relatively consistent frequency. This suggests that this animal was using regular "toilet areas", a characteristic that is common in captive animals (Hediger, 1964).

The high frequency of urinations may have been "fear-induced" (Halliday, 1966), with the "fear" being of the test situation per se, since an equally high frequency of urination was exhibited when no odors were introduced into the room.

The urination patterns exhibited by the adult males (coyotes K, I, and J) appeared to be cyclic in frequency, with a low in mid-November, and a peak in late February (Fig. 77). This cyclicity appeared to be in phase with the reproductive cycle, suggesting an association between marking behavior and testosterone secretion (see p. 81).

Of all of the experiments using the adult males there was a significant "between-odors" main effect only during the "K-I-J Experiment" ($P \leq 0.005$) in the frequency of urination (Figs. 66, 68, and 70). No animal-odor, or odor-week interaction was observed during any of the experiments. The differences in the data from the "K-I-J Experiment" resulted from the greater number of urinations that were directed toward a post containing the feces from a male domestic dog. During this study, fecal odors in general were associated with more urination patterns than were urine odors ($P \leq 0.05$, Chi-squared Test). The adult males urinated 159 times when tested with fecal odors, but only 110 times with urine odors.

If urine marking is motivated by aggression as Ralls (1971) believes, then fecal odors may be "threatening" to the male coyotes. The high frequency of urine marking associated with the feces from male domestic dogs during the coyote's breeding season suggests that the fecal odor of adult males may be especially "threatening" during this period.

The lack of animal-odor interactions in the frequency of urination during all of the experiments suggests that the adult males did not differ

in their response toward any of the test odors, including their own urine and feces. Von Uexküll and Sarris (1931), however, state that once a dog has urinated on an object, it is inhibited by the smell of its own urine from doing so again until another dog has used the site. This may not be the case. If a canid urinates on its own odor with the same frequency as on odors from other animals, it may be that the animal does not "recognize" its own urine or fecal odor. This concept will be discussed later.

Defecation

Ewer (1968) states that members of the family Canidae do not scent mark with feces. Kleiman (1966), however, reports that foxes and domestic dogs may display feces marking, although she appears to doubt its importance because of its infrequent occurrence.

During this study, defecating on the experimental posts was only displayed by the two high-ranking adult males, coyotes K and I, K being dominant over I. Both of these animals were tested 476 times during the course of this study, and during these tests, coyote K defecated on a post 8 times, while coyote I did this only 4 times (Table 7). Defecation may occasionally be a method of scent marking, since this rank differentiation is in accord with Ralls' (1971) statement that high-ranking animals mark more frequently than low-ranking animals.

The temporal distribution of the defecation patterns that were directed toward a post (Table 7) is also suggestive of scent marking, since 11 of the 12 patterns occurred during the "Urine, Feces, and K-I-O-S Experiments" when the animals were frequently marking with urine (Table 6). The one defecation pattern that occurred during the "K-I-J Experiment" was exhibited during the last week, in phase with the temporal distribution of

urine marking (Fig. 67).

The specific odors that the defecations were associated with are shown on Table 9. The sample size is too small to allow definite conclusions, but 10 of the 12 patterns were associated with urine odors. However, as previously discussed, marking with urine was associated with fecal odors. This suggests that urine and feces may each have a specific function in the transmission of information, and that the motivation for marking with them differs. Since feces may have an odor that is "threatening" to male coyotes, the depostion of urine may result in increased confidence, as Ewer (1968) suggests. Feces marking on urine odors, then, would imply that the animals are depositing a "threatening" substance in response to a "less threatening" odor. If this is true, then the primary function of feces marking may be to convey information about the marker to other animals, while that of urine marking may be to reassure the marker. Information in urine that is transmitted to other animals may occur secondarily.

Scratching Substrate After Elimination

Kleiman (1966) states that most males and some females of the genus *Canis* display scratching after marking with urine. Scott and Fuller (1965) remark that scratching the ground may follow a defecation pattern in the domestic dog, and probably functions as a visual mark, not an attempt to cover the feces. Young and Jackson (1951) state that coyotes scratch after urination to cover the deposit, while Ewer (1968) believes that scratching may be an intimidatory display. Fentress (1967) remarks that scratching by wolves normally occurs only in strange territories.

Scratching the ground after elimination has not been considered to be a method of scent marking. However, De Leeuw (1957) states that wild cats

(*Felis sylvestris*) have "claw-sharpening" trees which carry the odor of a foot secretion, and McCartney (1968) suggests that domestic dogs impart an individual odor to their tracks, possibly because of interdigital glands (Fox, 1971). Thus, scratching the ground could be a means of scent marking under certain conditions.

Scratching the substrate after elimination was never observed in the observation room. This behavioral pattern was, however, observed in the outdoor enclosures at Ellerslie by coyotes K, I, and J (adult males) before they were brought into the Bio-Science Building for the scent experiments, and by coyote J when he was moved back to Ellerslie, after the "Series Two Experiments". Coyotes K and I were never returned to the outdoor enclosures. The adult female that gave birth to all of the study animals also exhibited scratching after eliminative marking during the breeding season.

Scratching may not have been exhibited in the observation room because of the hard floor, although other behavioral patterns were noted that are typically associated with a soft substrate (e.g. digging, and covering food by pushing substrate with nose), and Fox (1971) states that domestic dogs display scratching on pavement.

If the presence of earth is not a requirement for the display of scratching, then the lack of any scratching in the observation room may reflect what the room "means" to the animals. Lindemann (1955) notes that the European lynx (*Lynx lynx*) and the wild cat bury their urine and feces only well within their territories, while near the boundries where marking occurs, no scratching is exhibited. If this is true for coyotes, then the observation room may be treated as a territorial boundary, or "neutral area". This suggests that scratching may not be a method of

scent marking, but may function to cover the deposit.

Anal Drag

In the order Carnivora, anal gland marking is characteristic of viverrids and mustelids, but rare, if at all present, in canids (Ewer, 1968). Kleiman (1966) reports a urination posture of a female bush dog (*Speothos venaticus*) that is similar to the handstand anal drag common in the viverrids (Ewer, 1968). Hart (1969) reported this handstand posture being displayed by a 2-year-old male beagle dog while defecating.

The anal drags that were exhibited by the study animals were recorded during all of the scent experiments. This behavioral pattern was characterized by the animal elevating its tail, and then wiping its anal region on the floor by pulling itself forwards for a short distance while in a sitting position.

During this study, the anal drag was exhibited in 15 of the 2994 tests performed (Table 12). This pattern followed defecation in 13 of the 15 occurrences, suggesting a relationship between defecation and the anal drag.

The adult males, coyotes K, I, and J, displayed 13 (5, 4, and 4, respectively) of the 15 anal drags, but they also exhibited 106 of the 128 defecations (Table 12), so no sex or rank differences were shown in the display of anal drags.

There was no significant difference (Fisher's Exact Test) between the number of anal drags associated with a defecation pattern that was directed toward a post, and the number of anal drags associated with a room defecation (Table 12). There does not appear to be any association between the anal drag and the test odor (Table 13).

Table 12. Relationship between the defecation frequency, the defecation site, and the display of the anal drags exhibited by the study animals during the various scent experiments.

		Defecation in Room		Defecation on Post		Without Defecation
Coyote	No. of Tests	No. of Defecations	No. of Anal Drags	No. of Defecations	No. of Anal Drags	No. of Anal Drags
K	476	33	2	8	2	1
I	476	30	4	4	0	0
J	368	31	4	0	0	0
M	254	0	0	0	0	0
P	280	19	0	0	0	0
O	290	0	0	0	0	0
Q	280	2	1	0	0	0
S	316	1	0	0	0	0
N	254	0	0	0	0	1
Total	2994	116	11	12	2	2

Table 13. Relationship between the test odor and the display of the anal drags exhibited by the study animals during the various scent experiments.

Experiment	Coyote Exhibiting Anal Drag	Test Odor
Urine	I (AM2-3)	Urine - coyote J
	I (AM2-3)	Urine - male dog
Feces	K (AM1-3)	Feces - anestrus dog
	I (AM2-3)	Feces - anestrus dog
	I (AM2-3)	Feces - coyote K
K-I-J	K (AM1-3)	No odor
	J (AM3-3)	Urine - coyote K
	J (AM3-3)	Feces - coyote K
	J (AM3-3)	Urine - coyote J
	J (AM3-3)	Feces - anestrus dog
M-O-N	None	
P-Q-S	Q (JF2-3)	Feces - coyote P
K-I-O-S	K (AM1-4)	Feces - coyote P
	K (AM1-4)	Urine - coyote N
	K (AM1-4)	Feces - coyote N
M-P-Q-N	N (AF4-4)	Feces - coyote O

These data suggest that the anal drags exhibited during this study were not involved in scent marking. Since anal drags could be induced by placing some feces on the anus, this pattern probably functions to clean the anal region, or relieve an irritation.

Individual Recognition by Urine and Fecal Odors

The role of olfaction in conspecific communication has been emphasized by several authors. Moore (1965) has demonstrated that deermice, *Peromyscus maniculatus*, show species-oriented behavior when exposed to odors from their own species and a closely related species. Group recognition has been shown in laboratory mice by Archer (1968), and in Richardson's ground squirrels, *Spermophilus richardsonii*, by Sheppard and Yoshida (1971). Recognition of sex, social status and breeding condition is also well documented, as has been previously discussed. However, information on recognition at the level of the individual is limited. Kalmus (1955) has shown that dogs can distinguish between identical twins, while Bowers and Alexander (1967) report that mice can distinguish between two males of the same strain. These results, however, were drawn from conditioning experiments, and data of this type do not permit the conclusion that the animals would respond to different individual odors in nature.

Individual recognition by urine or feces alone has never been demonstrated, although many authors (Mech, 1970; Scott and Fuller, 1965; Young and Goldman, 1944) believe that canids can recognize individual animals by the odor of their eliminations, despite the lack of evidence. During this study, data on total time spent at the odor post during the "M-O-N and P-Q-S Experiments" may contribute to the eventual solution of

this problem.

Since these experiments were designed as mirror-images of each other, mirror-image results were expected in the response of each group of coyotes to elimination from group animals, and from non-group animals. In other words, urine from the dominant male of the test group would be recognized as such, and responded to accordingly, while urine from the dominant male of the other group would not be recognized, and probably responded to differently. When these experiments were compared on this basis, no significant correlation between experiments was exhibited (Fig. 78; Set A), suggesting that coyotes do not exhibit a recognition response to odors from litter mates that they have had a recent association with. However, when the experiments were compared on the basis of the response associated with the odor from each animal (Fig. 78; Set B), a significant relationship was demonstrated ($P \leq 0.06$). This indicates that both groups of coyotes responded in a similar fashion to the odor of a specific animal, regardless of whether or not the animal was from their group, suggesting that the odor from each specific animal elicited a "type" response from both group and non-group litter mates.

These data, then, suggest that the response exhibited to an odor from a litter mate may not be influenced by a recent association with the animal that contributed the odor. The response itself may be a "type" response that is elicited by all animals in the same stimulus situation. The coyotes did not appear to exhibit a recognition response to an individual animal's odor per se. It may be that the response is to a supra-individual odor composed of a spectrum of odors representing factors such as species, litter, sex, breeding condition and social status. Archer (1968) and Parkes (1960) have suggested this possibility in mice.

CONCLUSION

Captive coyotes appear to respond differentially to canid odors. The type, and frequency of response appears to be closely associated with the reproductive cycle of both sexes, probably because of changes in the physiological condition of the animals, and in correlated changes in the odor of eliminations.

Coyotes discriminate among both urine and fecal odors on the basis of sex, breeding condition, and social status. The "threatening" component in feces appeared to be most significant during the breeding season, and in the spring. During the breeding season, adult males responded to the odor of an adult male's feces by displaying an increase in urine marking. In the spring, the feces from a dominant adult male appeared to produce an avoidance reaction in adult females and sub-adult males. The source of information in urine may be steroids, and in feces, anal gland secretions. The composition of the odors, however, was not analysed.

Coyotes do not appear to exhibit a recognition response to their own elimination, or to elimination from litter mates they were recently associated with. The response exhibited to an odor may be a "type" response, for an animal with a specific motivation, to a "type" odor representing the supra-individual.

Urine and feces from domestic dogs appear to be of biological significance to coyotes. The responses to dog scents were consistent with those to coyote scents, in terms of sex and breeding condition, but frequently of a stronger nature. The apparent "intensity" of response may be

related, at least in part, to the possibility that there is greater contrast between coyote and dog scents than within coyote scents, especially since all of the coyotes were from the same parents.

Captive coyotes appear to scent mark with urine and feces. Urine marking is the most frequent, although feces marking may be the most important in terms of significance to other animals. Urine marking may function for "self-reassurance" with an aggressive motivation.

Scent marking was displayed only by the adult males during this study, with the high-ranking males marking most frequently. The subordinate male (coyote J) exhibited a high frequency of urinations, but this was interpreted as being "fear-induced" urinations in regular "toilet areas". There appears to be a cyclicity in marking that is in phase with the reproductive cycle.

Body rubbing was interpreted as being "self-marking", not as scent marking per se. This pattern was displayed only by the adult males, with the high-ranking males rubbing most frequently. Novelty and/or oddity of "interesting" odors may motivate rubbing. However, different odors appear to become "interesting" at different stages of the coyote's reproductive cycle, suggesting an association between breeding condition and body rubbing.

Scratching the substrate after elimination, and dragging the anal region do not appear to be involved in scent marking. Scratching may function to cover the deposit, while the anal drag may function as a cleaning mechanism.

LITERATURE CITED

Archer, J. 1968. The effect of strange male odor on aggressive behavior in male mice. J. Mamm. 49:572-575.

Beach, F.A., and R.W. Gilmore. 1949. Responses of male dogs to urine from females in heat. J. Mamm. 30:391-392.

Beeman, E.A. 1947. The effect of male hormone on aggressive behavior in mice. Physiol. Zool. 20:373-405.

Bowers, J.M., and B.K. Alexander. 1967. Mice: individual recognition by olfactory cues. Science 158:1208-1210.

De Leeuw, A. 1957. Die Wildkatze. Merkbl. Niederwild. Lt. Jazd-schutzverb. No. 16.

Eibl-Eibesfeldt, I. 1950. Über die Jugendentwicklung des Verhaltens eines männlichen Dachses (*Meles meles* L.) unter besonderer Berücksichtigung des Spieles. Z. Tierpsychol. 7:327-355.

Ewer, R.F. 1968. Scent marking, p. 104-133. In R.F. Ewer, Ethology of mammals. Logos Press Ltd., London.

Fentress, J.C. 1967. Observations on the behavioral development of a hand-reared male timber wolf. Am. Zoologist 7:339-351.

Fox, M.W. 1969. The anatomy of aggression and its ritualization in Canidae: a developmental and comparative study. Behaviour 35:242-258.

Fox, M.W. 1970. A comparative study of the development of facial expressions in canids; wolf, coyote and foxes. Behaviour 36:49-73.

Fox, M.W. 1971. Behaviour of wolves, dogs and related canids. Jonathan Cape Ltd., London. 214 p.

Fuller, J.L., and E.M. Du Buis. 1962. The behaviour of dogs, p. 415-452. In E.S.E. Hafez (ed.), The behaviour of domestic animals. Bailliere, Tindall and Cox, London.

Halliday, M.S. 1966. Exploration and fear in the rat, p. 45-59. In P.A. Jewell and C. Loizos (ed.), Play, exploration and territory in mammals. Symp. Zool. Soc. London. No. 18.

Hamlett, G.W.D. 1938. The reproductive cycle of the coyote. U.S. Dept. Agr. Tech. Bull. 616. 11 p.

Hart, B.L. 1969. Unusual defecation behaviour in the male dog. Comm. in Behav. Biol. 4:237-238.

Hediger, H. 1964. Wild animals in captivity. Dover Publications, Inc., New York. 207 p.

Hesterman, E.R., and R. Mykytowycz. 1968. Some observations on the odours of anal gland secretions from the rabbit, *Oryctolagus cuniculus* (L.). CSIRO Wildl. Res. 13:71-81.

Hildebrand, M. 1952. The integument in Canidae. J. Mamm. 33:419-428.

Hoar, W.S. 1966. General and comparative physiology. Prentice-Hall, Inc., Englewood Cliffs, New Jersey. 815 p.

Jolly, A. 1966. Lemur behavior, a Madagascar field study. Univ. of Chicago Press, Chicago. 187 p.

Kalmus, H. 1955. The discrimination by the nose of the dog of individual human odours and in particular of the odours of twins. Brit. J. Animal Behav. 3:25-31.

Kaufmann, J.H. 1962. Ecology and social behavior of the coati, *Nasua narica*, on Barro Colorado Island, Panama. Univ. Calif. Publ. Zool. 60:95-222.

Kean, R.I. 1967. Behavior and territorialism in *Trichosurus vulpecula* (Marsupialia). Proc. N.Z. Ecol. Soc. 14:71-78.

Kleiman, D. 1966. Scent marking in the Canidae, p. 167-177. In P.A. Jewell and C. Loizos (ed.), Play, exploration and territory in mammals. Symp. Zool. Soc. London. No. 18.

Korytin, S.A. 1970. Ethological variability of predatory mammals. Ecology (translated from Ékologiya) 1:198-204.

Krames, L., W.J. Carr, and B. Bergman. 1969. A pheromone associated with social dominance among male rats. Psychonomic Sci. 16:11-12.

Levine, N.D., M.N. Krehna, D.T. Clark, and I. Aves. 1960. Comparison of nematode egg counting techniques for cattle and sheep feces. Amer. J. Vet. Res. 21:511-515.

Lindemann, W. 1955. Über die Jugendentwicklung beim Luchs (*Lynx l. lynx* Kerr) und bei der Wildkatze (*Felis s. silvestris* Schreb.). Behaviour 8:1-46.

Lockie, J.D. 1966. Territory in small carnivores, p. 143-165. In P.A. Jewell and C. Loizos (ed.), Play, exploration and territory in mammals. Symp. Zool. Soc. London. No. 18.

Lorenz, K. 1954. Man meets dog. Methuen, London. 198 p.

McCartney, W. 1968. Olfaction and odours, an osphrésiological essay. Springer-Verlag, New York. 249 p.

Martins, T., and J.R. Valle. 1948. Hormonal regulation of the micturition behavior of the dog. J. Comp. Physiol. Psychol. 41:301-311.

Mech, L.D. 1970. The wolf: the ecology and behavior of an endangered species. Natural History Press, Garden City, New York. 384 p.

Meyer-Holzapfel, M. 1957. Das Verhalten der Bären (Ursidae). Handb. Zool. Berl. 8:1-36.

Moore, R.E. 1965. Olfactory discrimination as an isolating mechanism between *Peromyscus maniculatus* and *Peromyscus polionotus*. Amer. Midl. Nat. 73:85-100.

Müller-Schwarze, D. 1969. Complexity and relative specificity of a mammalian pheromone. Nature 223:525-526.

Murie, A. 1940. Ecology of the coyote in the Yellowstone. U.S. Dept. Int., Natl. Park Serv., Fauna Bull. 4. 206 p.

Mykytowycz, R. 1966. Observations on odoriferous and other glands in Australian wild rabbit, *Oryctolagus cuniculus* (L.), and the hare, *Lepus europaeus* (P.). Part I. The Anal Gland. CSIRO Wildl. Res. 11:11-29.

Neal, B.J. 1959. A contribution on the life history of the collared peccary in Arizona. Amer. Midl. Nat. 61:177-190.

Ozoga, J.J., and E.M. Harger. 1966. Winter activities and feeding habits of northern Michigan coyotes. J. Wildl. Mgt. 30:809-818.

Parkes, A.S. 1960. The role of odorous substances in mammalian reproduction. J. Reprod. Fertil. 1:312-314.

Ralls, K. 1971. Mammalian scent marking. Science 171:443-449.

Ropartz, Ph. 1968. Le rôle de l'olfaction dans le comportement social des Souris mâles. Rev. Comp. Animal. 2:1-39.

Rutter, R.J., and D.H. Pimlott. 1968. The world of the wolf. J.B. Lippincott Co., New York. 202 p.

Schenkel, R. 1948. Ausdruck-studien an Wölfen. Behaviour 1:81-129.

Schenkel, R. 1966. Play, exploration and territoriality in the wild lion, p. 11-22. In P.A. Jewell and C. Loizos (ed.), Play, exploration and territory in mammals. Symp. Zool. Soc. London. No. 18.

Scott, J.P., and J.L. Fuller. 1965. Genetics and the social behavior of the dog. Univ. of Chicago Press, Chicago. 468 p.

Sheppard, D.H., and S.M. Yoshida. 1971. Social behavior in captive Richardson's ground squirrels. J. Mamm. 52:793-799.

Skirrow, M. 1969. Behavioral studies of five Microtine species. Ph.D. Thesis. Univ. of Calgary, Calgary, Alberta. 211 p.

Sokal, R.R., and F.J. Rohlf. 1969. Biometry, the principles and practice of statistics in biological research. W.H. Freeman and Co., San Francisco. 776 p.

Steel, R.G.D., and J.H. Torrie. 1960. Principles and procedures of statistics, with special reference to the biological sciences. McGraw-Hill Book Co., Inc., Toronto. 481 p.

Thiessen, D., H. Friend, and G. Lindzey. 1968. Androgen control of territorial marking in the Mongolian gerbil. Science 160:432-434.

Van Wormer, J. 1964. The world of the coyote. J.B. Lippincott Co., New York. 150 p.

Von Uexküll, J., and E.G. Sarris. 1931. Das Duftfeld des Hundes. Z. Hundeforschung 1:55-68.

Wolfram, G. 1964. Coyotes: the silent invaders. Can. Audubon 26:112-115.

Wynne-Edwards, V.C. 1962. Animal dispersion in relation to social behavior. Oliver and Boyd, London. 653 p.

Young, S.P., and E.A. Goldman. 1944. The wolves of North America. I-II. Dover Publications, Inc., New York. 636 p.

Young, S.P., and H.H.T. Jackson. 1951. The clever coyote. Wildl. Mgt. Inst., Washington. 411 p.

Zannier, F. 1965. Verhaltensuntersuchungen an der Zwergmanguste, *Helogale undulata rufula* im Zoologischen Garten Frankfurt am Main. Z. Tierpsychol. 22:672-695.

Fig. 1. Pedigree of coyotes utilized during this study. The 1969 litter was born on April 28, and the 1970 litter on April 23. A male is indicated by a square, a female by a circle. The solid symbols indicate the animals used.

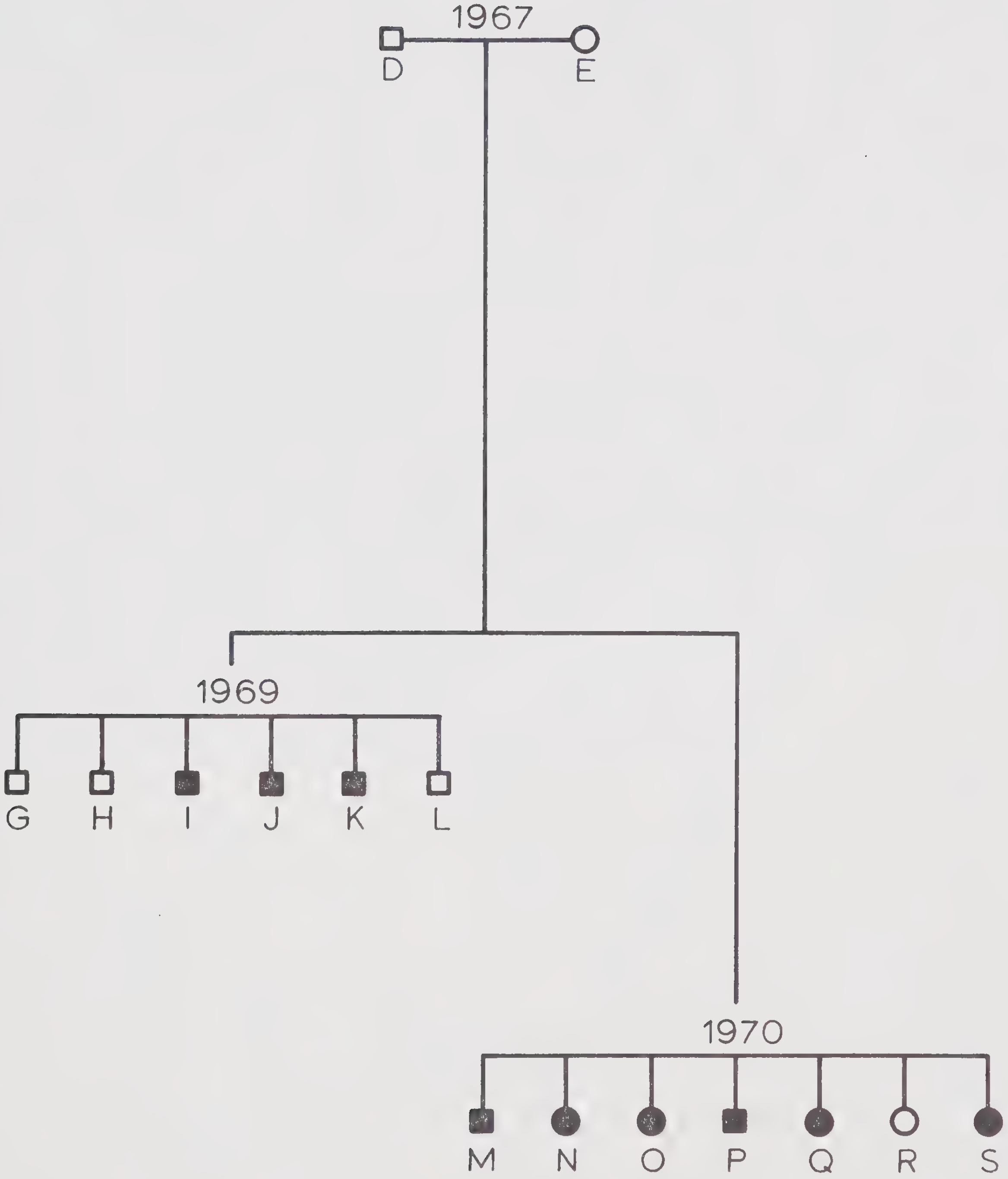
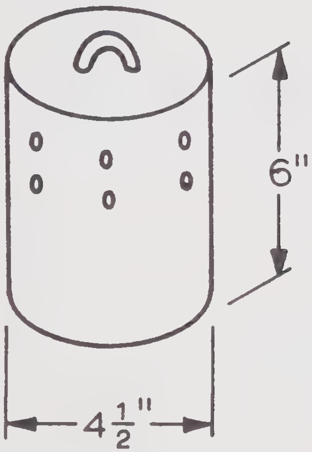

1967
D
E
1969
G
H
I
J
K
L
1970
M
N
O
P
Q
R
S

Fig. 2. Metal posts utilized as odor and control posts during this study.

PROTECTIVE COVER



VIAL HOLDER

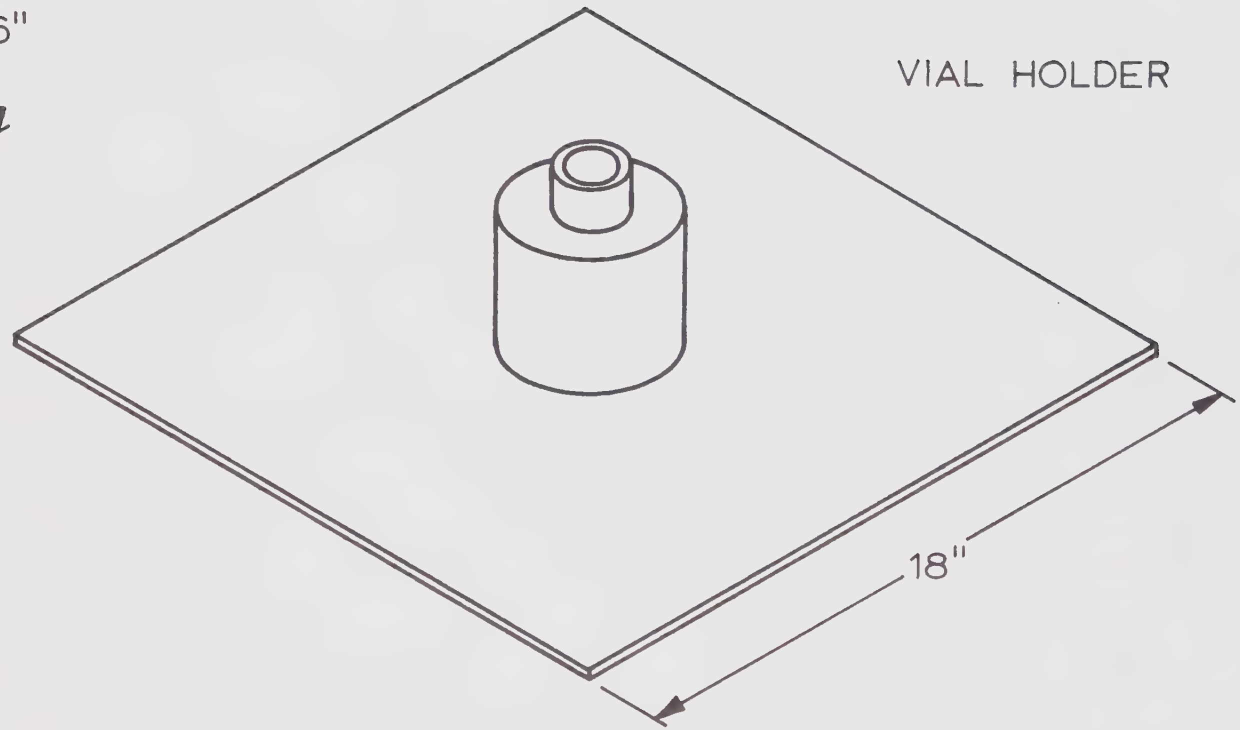


Fig. 3. Automatic release cage utilized during this study.

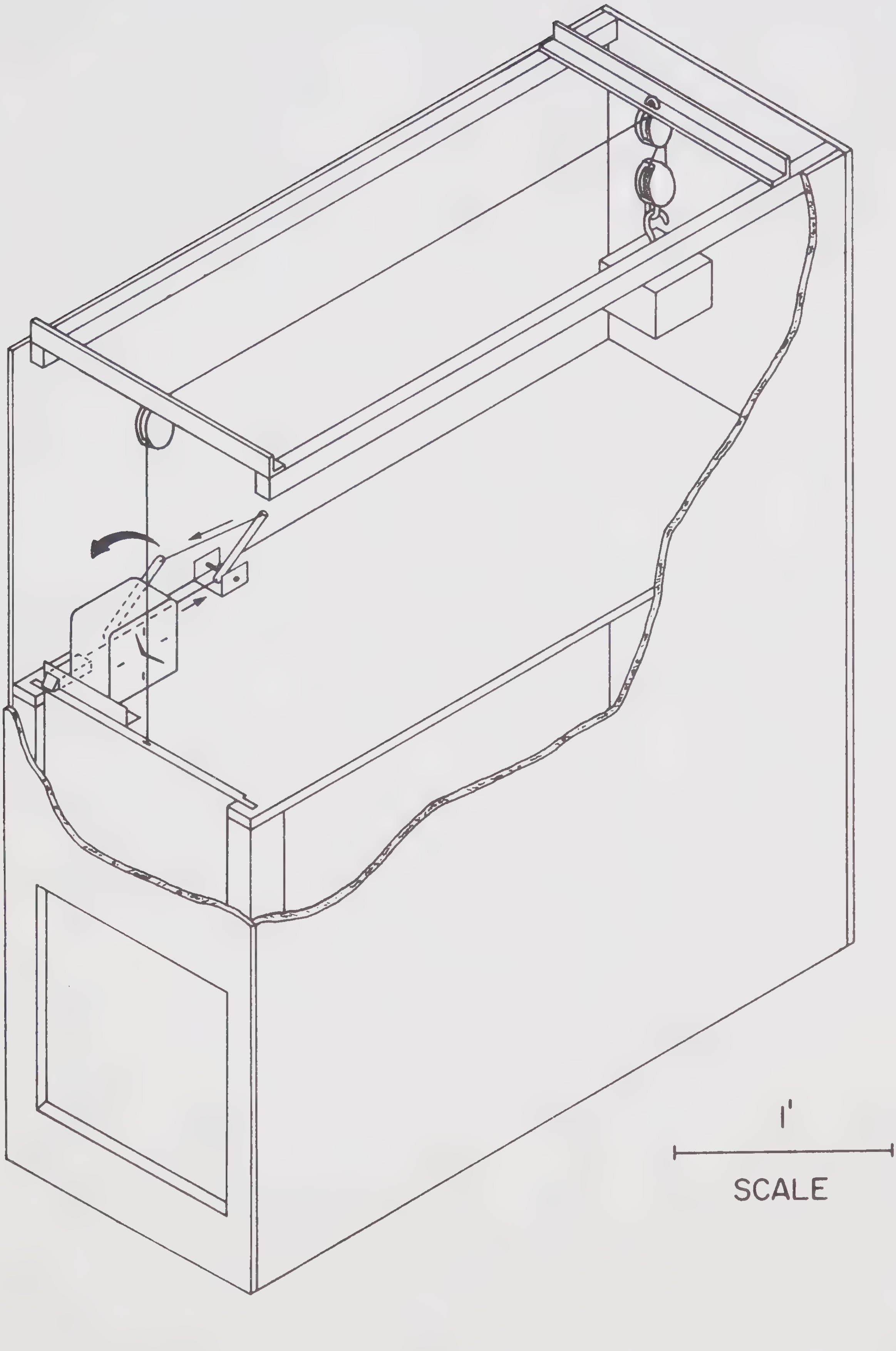
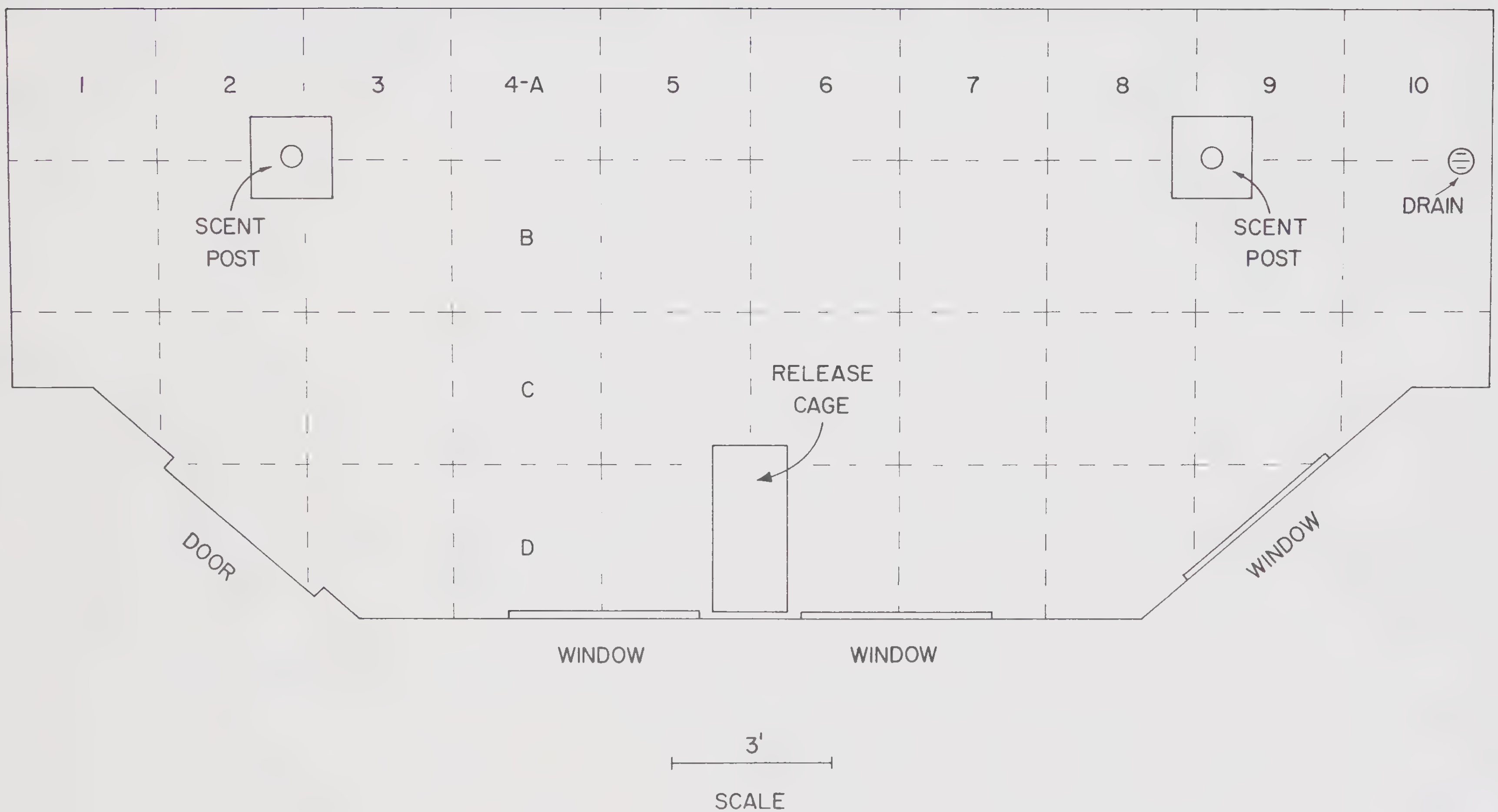
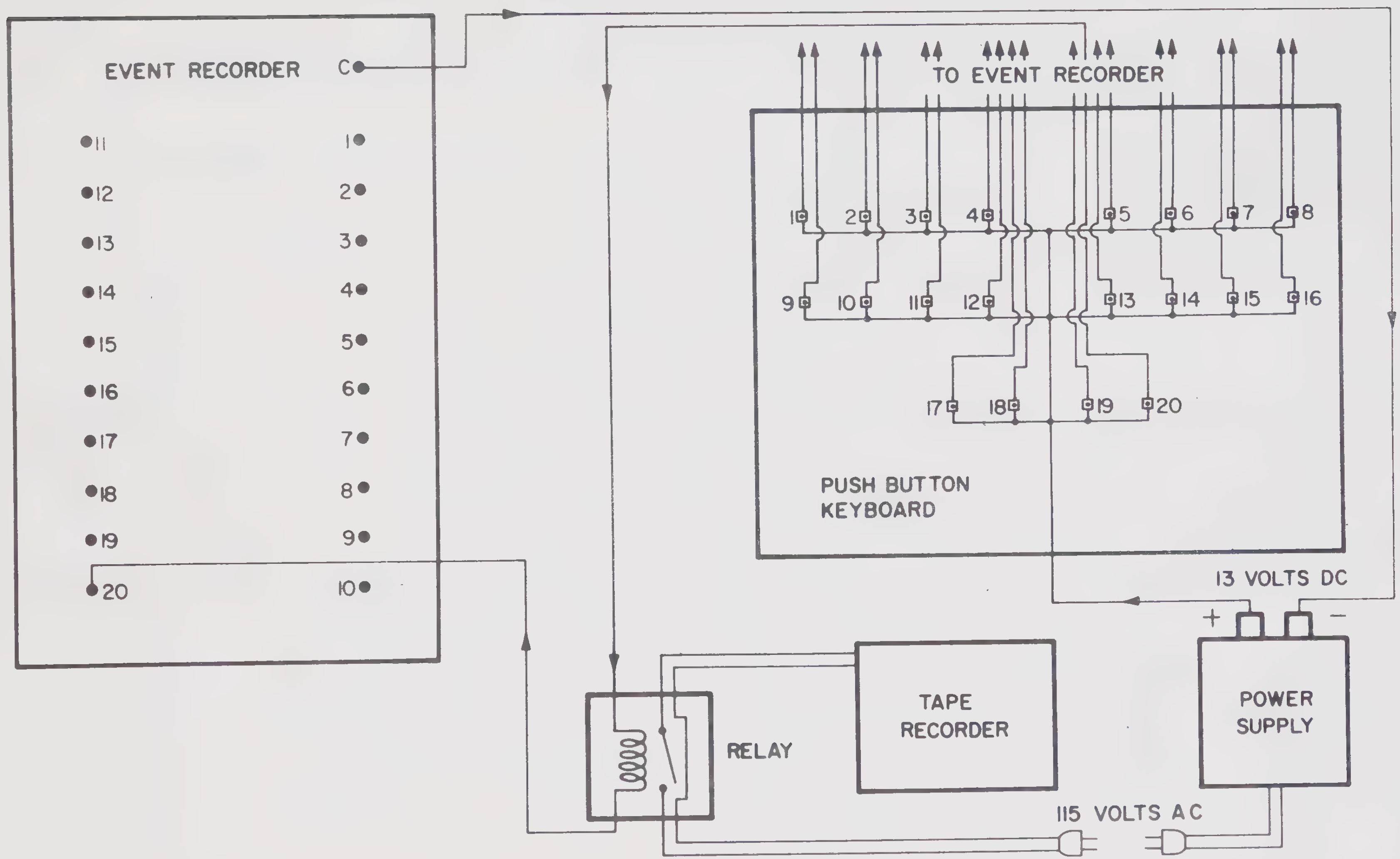

1'
SCALE

Fig. 4. Location of apparatus in the observation room, and the imaginary grid and numeration used to record spatial orientation of the study animals.



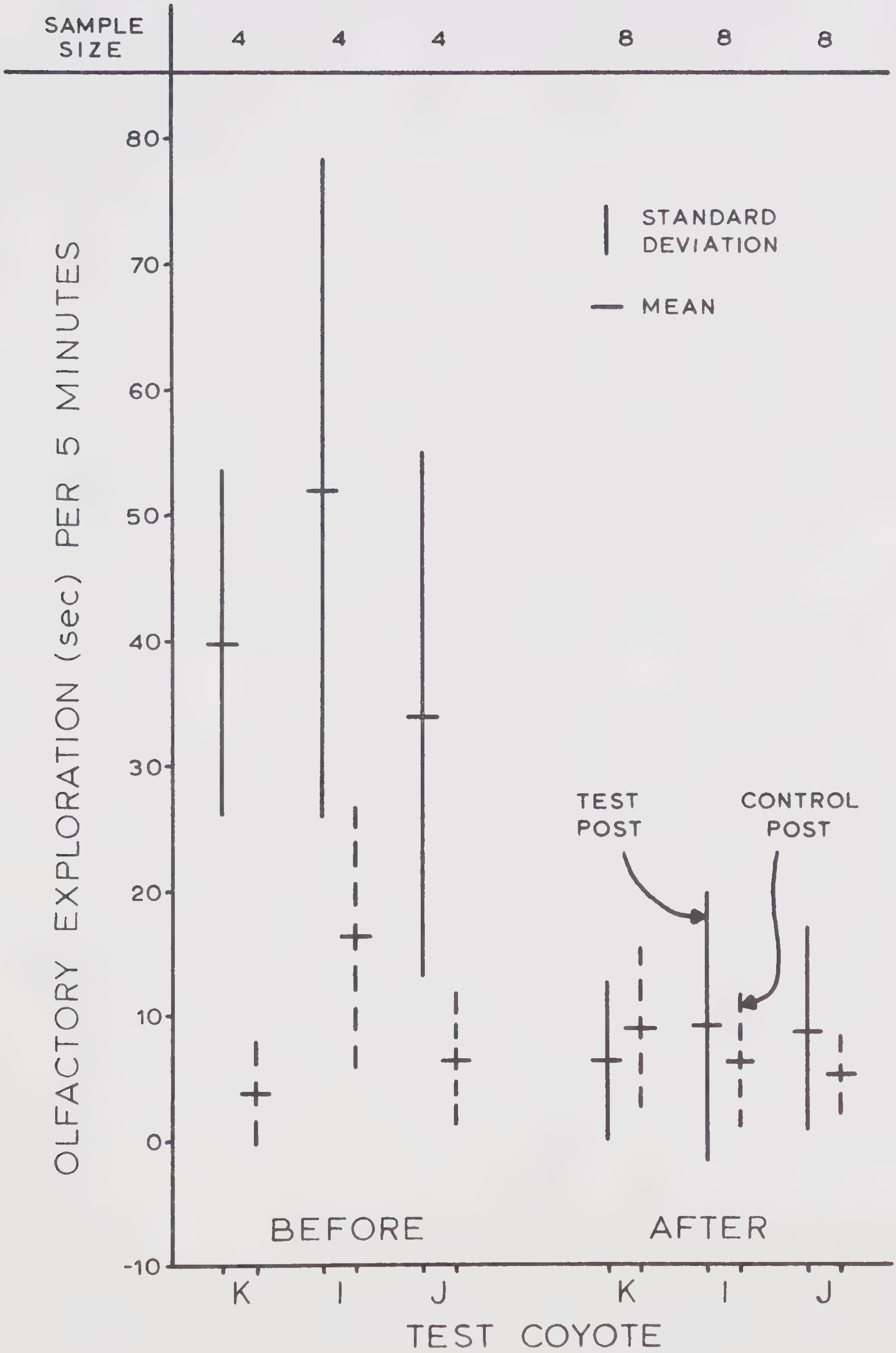
1
2
3
4-A
5
6
7
8
9
10
B
C
D
SCENT POST
SCENT POST
DRAIN
RELEASE CAGE
DOOR
WINDOW
WINDOW
WINDOW
3'
SCALE

Fig. 5. Wiring diagram of the apparatus used to record behavior.



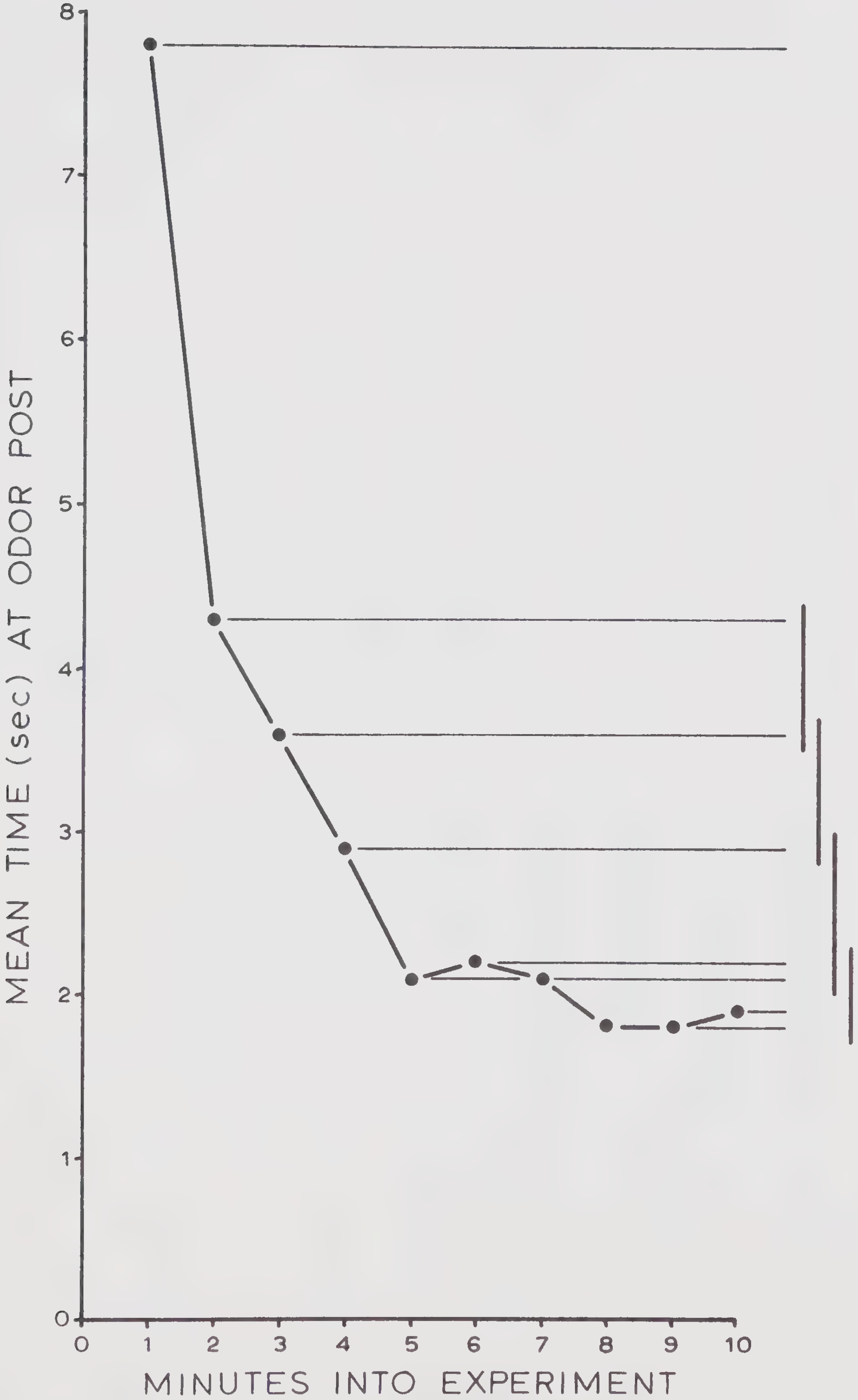
EVENT RECORDER
C
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
TO EVENT RECORDER
PUSH BUTTON
KEYBOARD
13 VOLTS DC
+
−
POWER
SUPPLY
TAPE
RECORDER
RELAY
115 VOLTS AC

Fig. 6. Evaluation of the technique of scent-masking. The test odor used was urine from a female domestic dog (estrus).



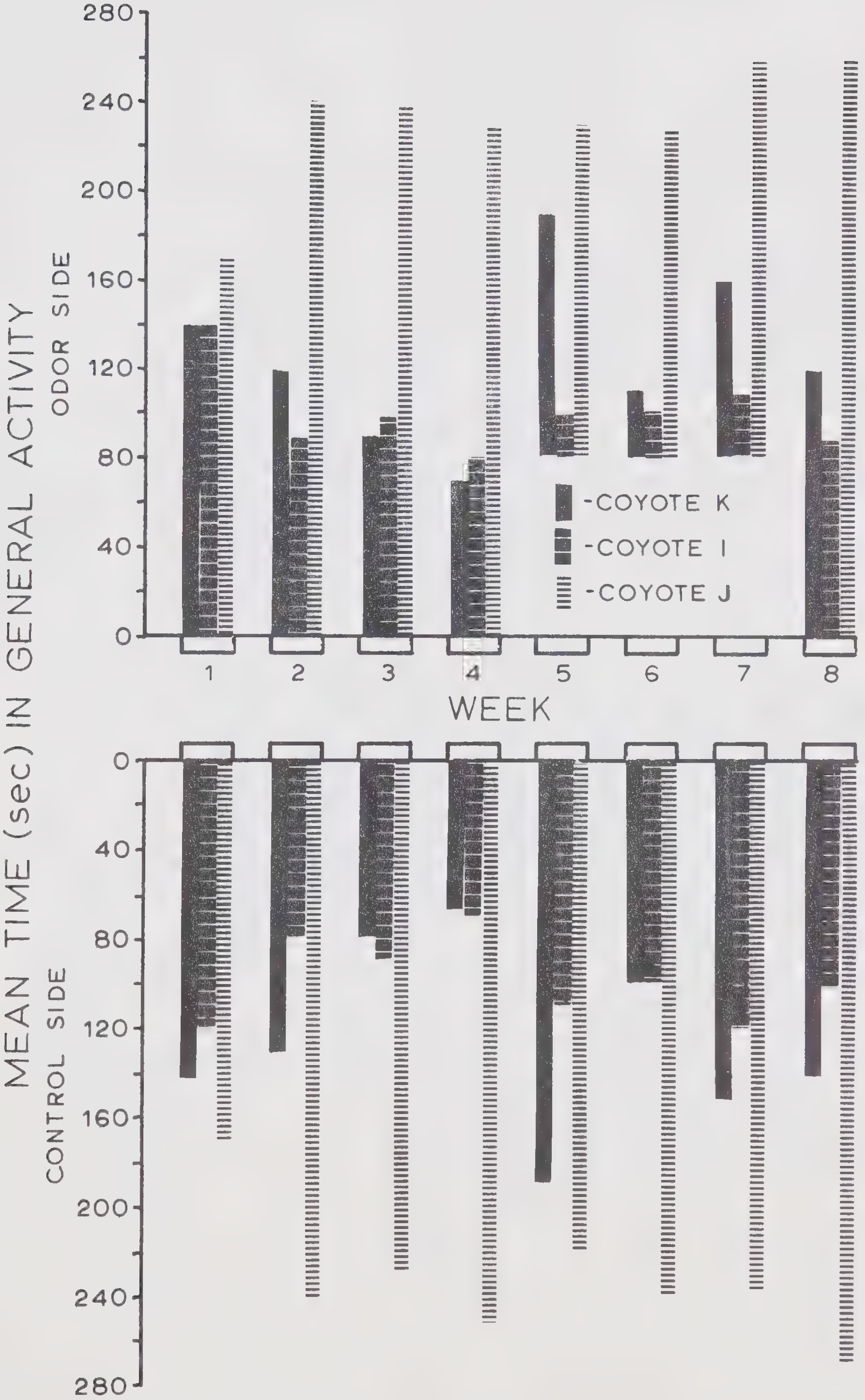
SAMPLE SIZE
4
4
4
8
8
8
80
70
60
50
40
30
20
10
0
-10
OLFACTORY EXPLORATION (sec) PER 5 MINUTES
STANDARD DEVIATION
MEAN
TEST POST
CONTROL POST
BEFORE
AFTER
K
I
J
K
I
J
TEST COYOTE

Fig. 7. Temporal distribution of the time that coyotes K, I, and J spent at the odor post (480 exposures) during the "Series One Experiments", over the period June 22 to August 20, 1970. Any two values not included with the same vertical line are significantly different ($P \leq 0.05$).



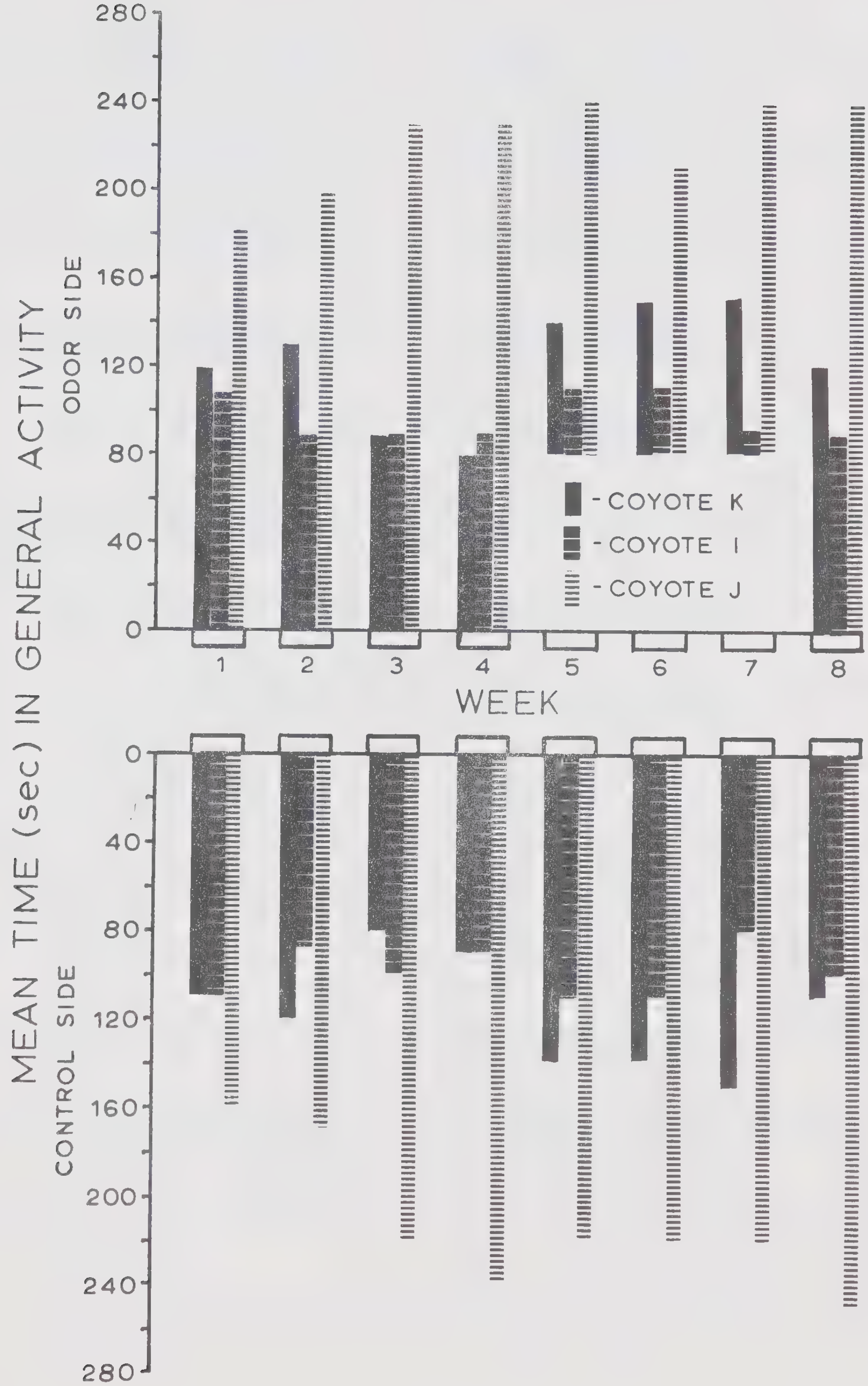
MEAN TIME (sec) AT ODOR POST
0
1
2
3
4
5
6
7
8
0
1
2
3
4
5
6
7
8
9
10
MINUTES INTO EXPERIMENT

Fig. 8. Relationship between the week of the experiment and the time spent in general activity that coyotes K, I, and J exhibited during the "Urine Experiment", over the period June 22 to August 20, 1970.



MEAN TIME (sec) IN GENERAL ACTIVITY
ODOR SIDE
CONTROL SIDE
WEEK
-COYOTE K
-COYOTE I
-COYOTE J
280
240
200
160
120
80
40
0
1
2
3
4
5
6
7
8

Fig. 9. Relationship between the week of the experiment and the time spent in general activity that coyotes K, I, and J exhibited during the "Feces Experiment", over the period June 23 to August 19, 1970.



MEAN TIME (sec) IN GENERAL ACTIVITY
ODOR SIDE
CONTROL SIDE
280
240
200
160
120
80
40
0
1
2
3
4
5
6
7
8
WEEK
- COYOTE K
- COYOTE I
- COYOTE J

Fig. 10. Relationship between the test odor and the time spent in general activity that coyotes K, I, and J exhibited during the "K-I-J Experiment", over the period September 14, 1970 to February 23, 1971. The odors used were:

1. Urine - coyote K (G-AM1-3)
2. Feces - "
3. Urine - coyote I (G-AM2-3)
4. Feces - "
5. Urine - coyote J (G-AM3-3)
6. Feces - "
7. Urine - male domestic dog
8. Feces - "
9. Urine - female domestic dog (anestrus)
10. Feces - "
11. Urine - female domestic dog (estrus)
12. Feces - "
13. No odor

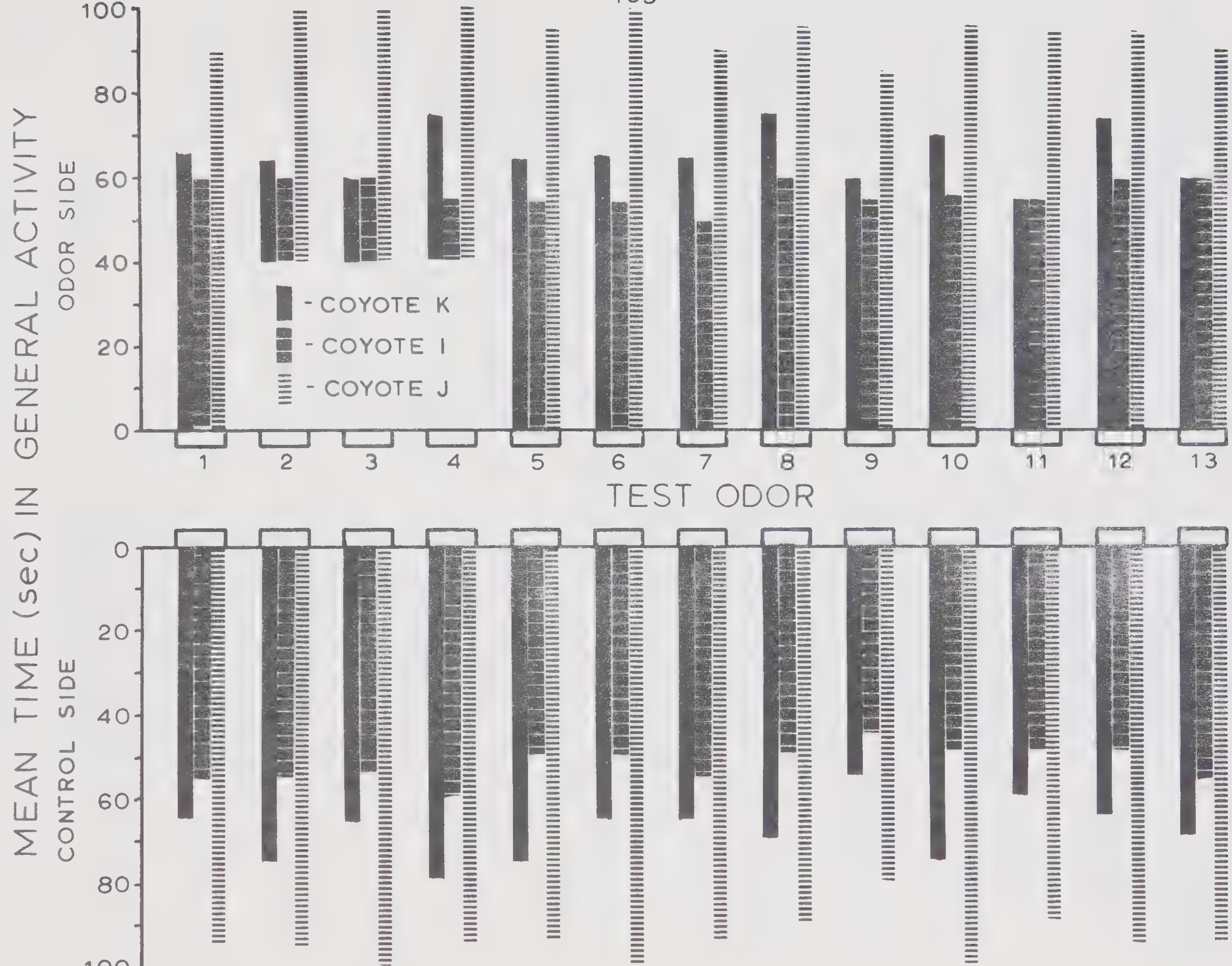

MEAN TIME (sec) IN GENERAL ACTIVITY
ODOR SIDE
CONTROL SIDE
100
80
60
40
20
0
- COYOTE K
- COYOTE I
- COYOTE J
1
2
3
4
5
6
7
8
9
10
11
12
13
TEST ODOR

Fig. 11. Relationship between the week of the experiment and the time spent in general activity that coyotes K, I, and J exhibited during the "K-I-J Experiment", over the period September 14, 1970 to February 23, 1971.

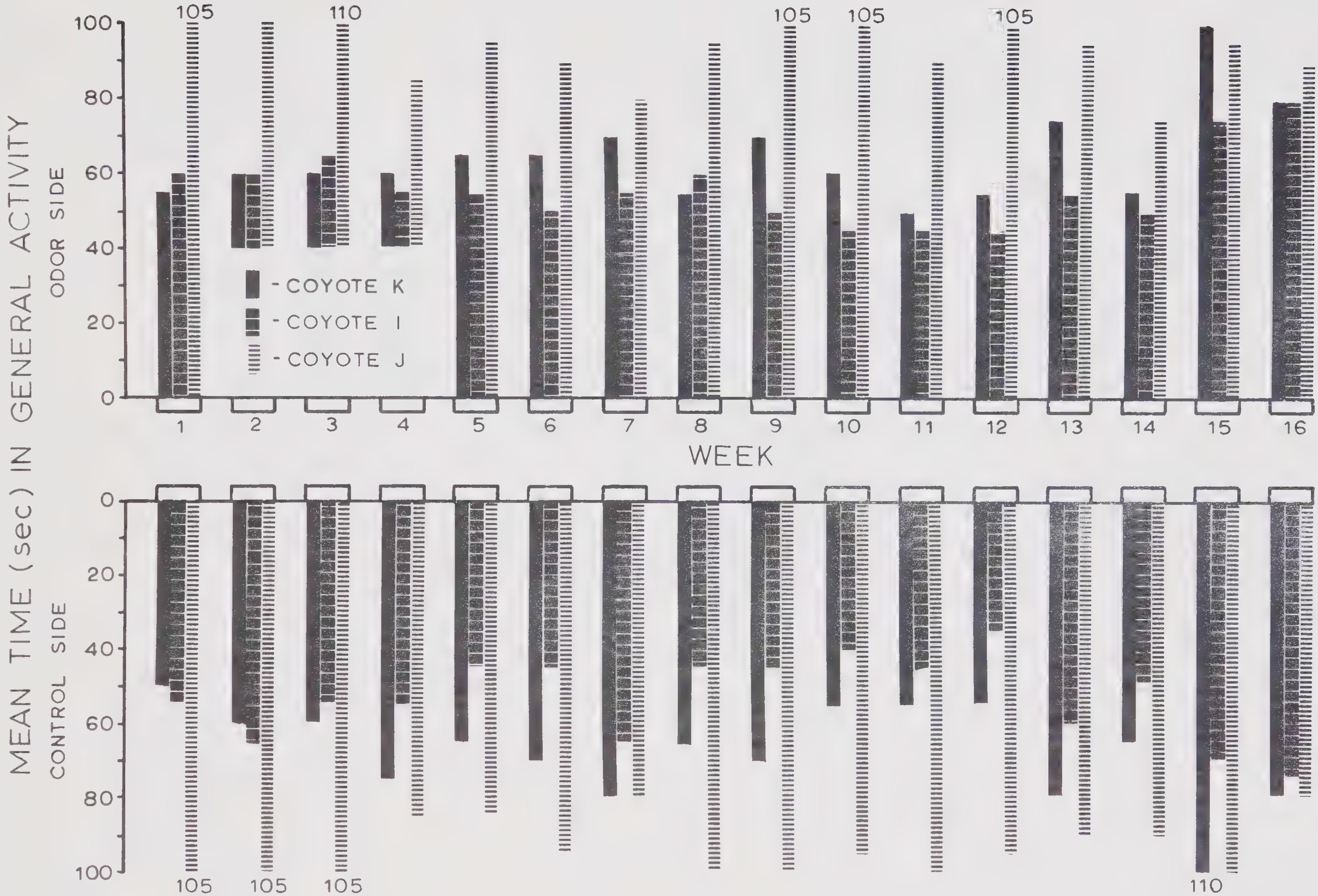
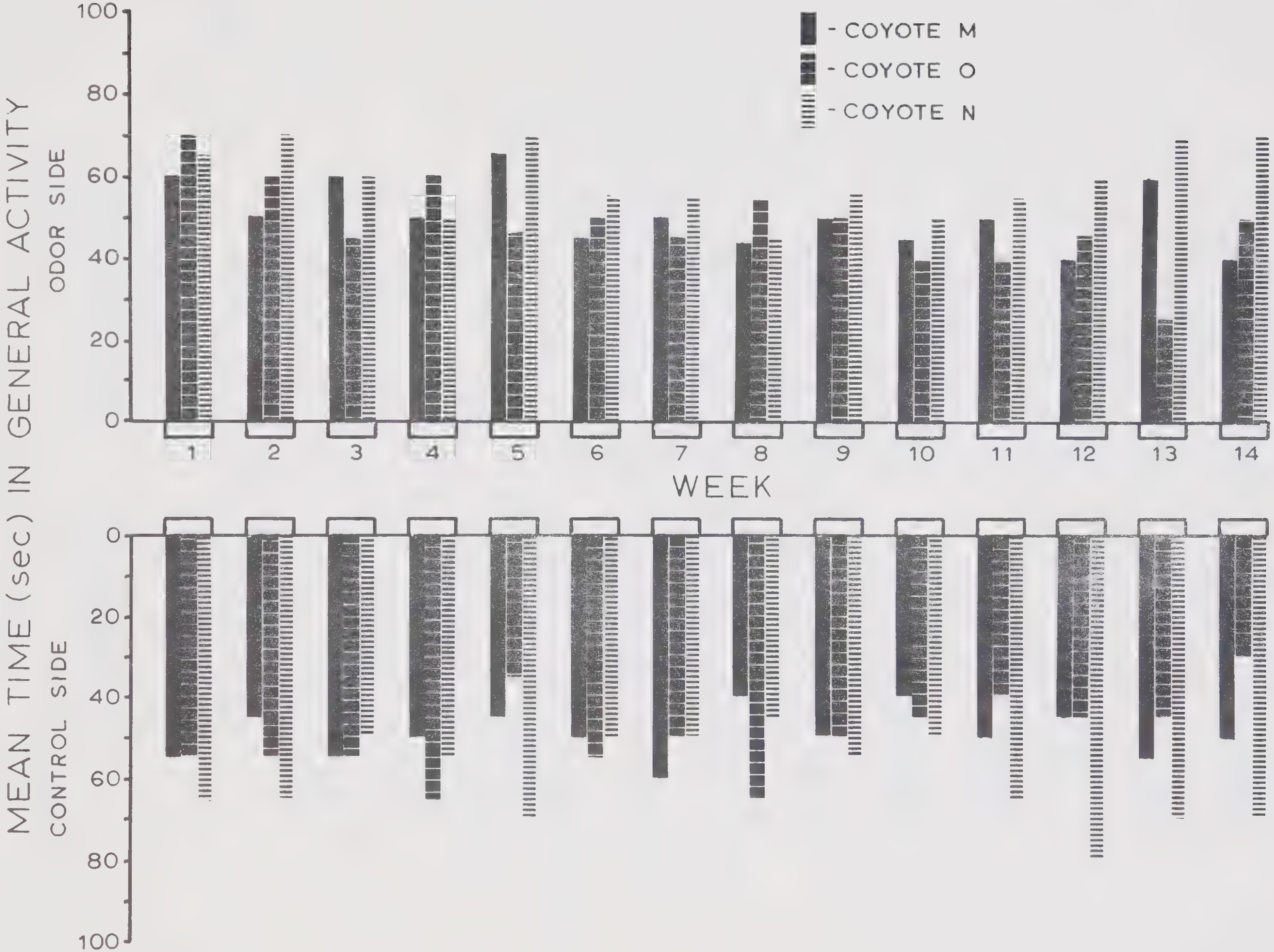
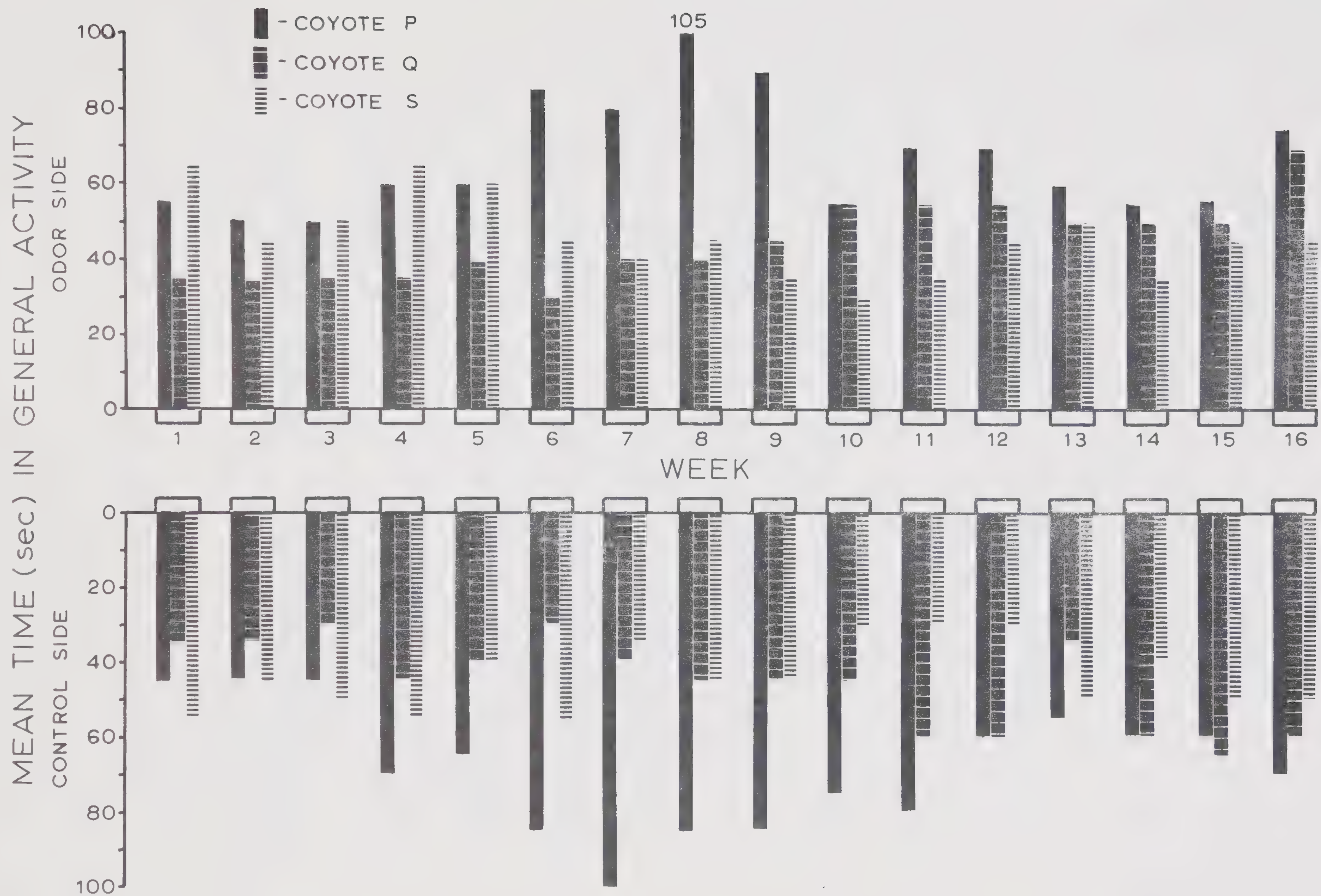

MEAN TIME (sec) IN GENERAL ACTIVITY
ODOR SIDE
CONTROL SIDE
WEEK
- COYOTE K
- COYOTE I
- COYOTE J
0
20
40
60
80
100
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
105
110

Fig. 12. Relationship between the week of the experiment and the time spent in general activity that coyotes M, O, and N exhibited during the "M-O-N Experiment", over the period September 15, 1970 to February 3, 1971.



MEAN TIME (sec) IN GENERAL ACTIVITY
ODOR SIDE
CONTROL SIDE
WEEK
- COYOTE M
- COYOTE O
- COYOTE N
100
80
60
40
20
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14

Fig. 13. Relationship between the week of the experiment and the time spent in general activity that coyotes P, Q, and S exhibited during the "P-Q-S Experiment", over the period September 16, 1970 to February 25, 1971.



- COYOTE P
- COYOTE Q
- COYOTE S
105
MEAN TIME (sec) IN GENERAL ACTIVITY
ODOR SIDE
CONTROL SIDE
0
20
40
60
80
100
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
WEEK

Fig. 14. Relationship between the test odor and the time spent in general activity that coyotes K, I, O, and S exhibited during the "K-I-O-S Experiment", over the period March 30 to July 22, 1971. The odors used were:

1. Urine - coyote M (N-JM1-4)
2. Feces - "
3. Urine - coyote P (N-JM2-4)
4. Feces - "
5. Urine - coyote Q (N-AF3-4)
6. Feces - "
7. Urine - coyote N (N-AF4-4)
8. Feces - "
9. No odor

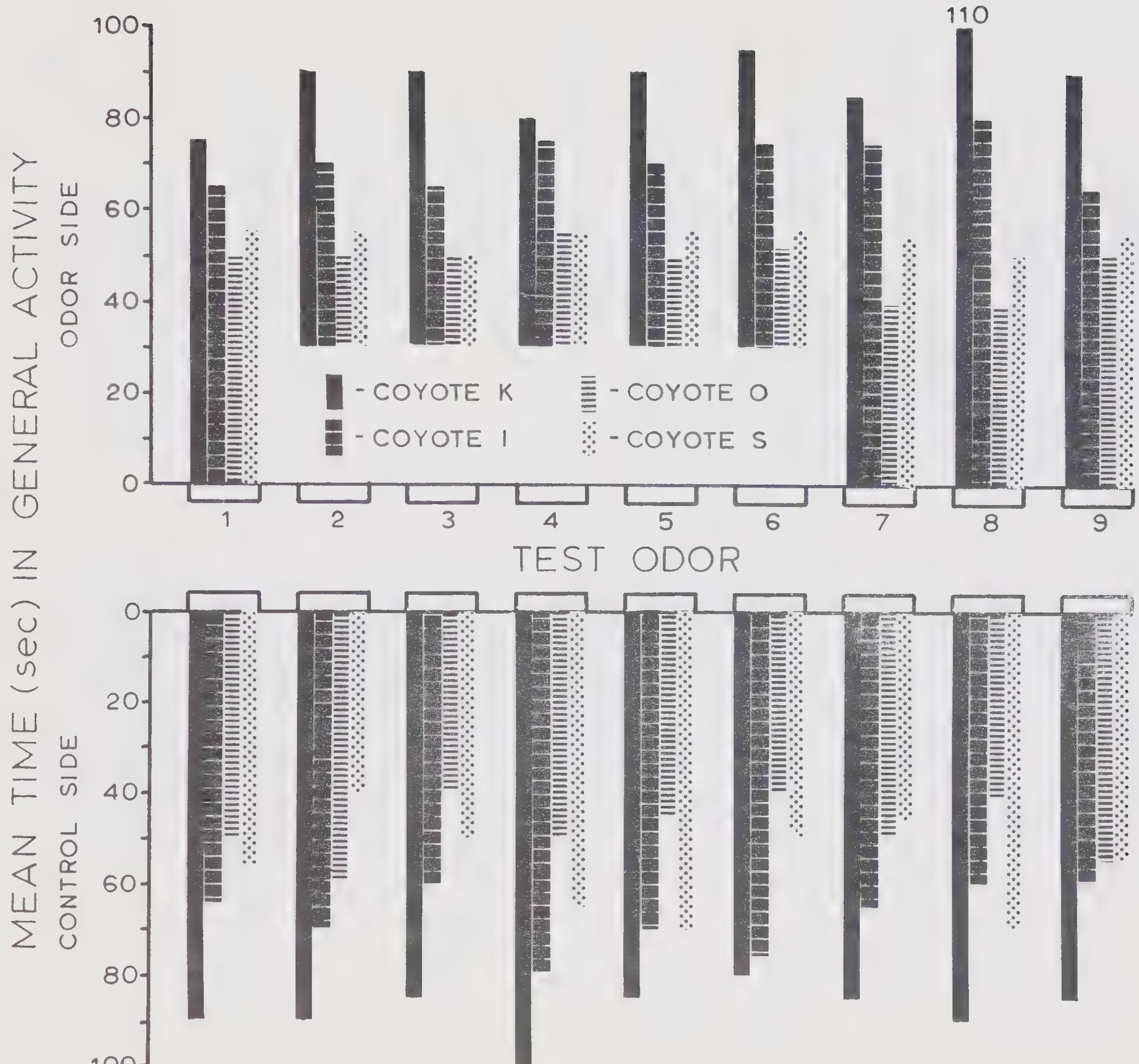

MEAN TIME (sec) IN GENERAL ACTIVITY
ODOR SIDE
CONTROL SIDE
110
- COYOTE K
- COYOTE I
- COYOTE O
- COYOTE S
1
2
3
4
5
6
7
8
9
TEST ODOR
0
20
40
60
80
100

Fig. 15. Relationship between the week of the experiment and the time spent in general activity that coyotes K, I, O, and S exhibited during the "K-I-O-S Experiment", over the period March 30 to July 22, 1971.

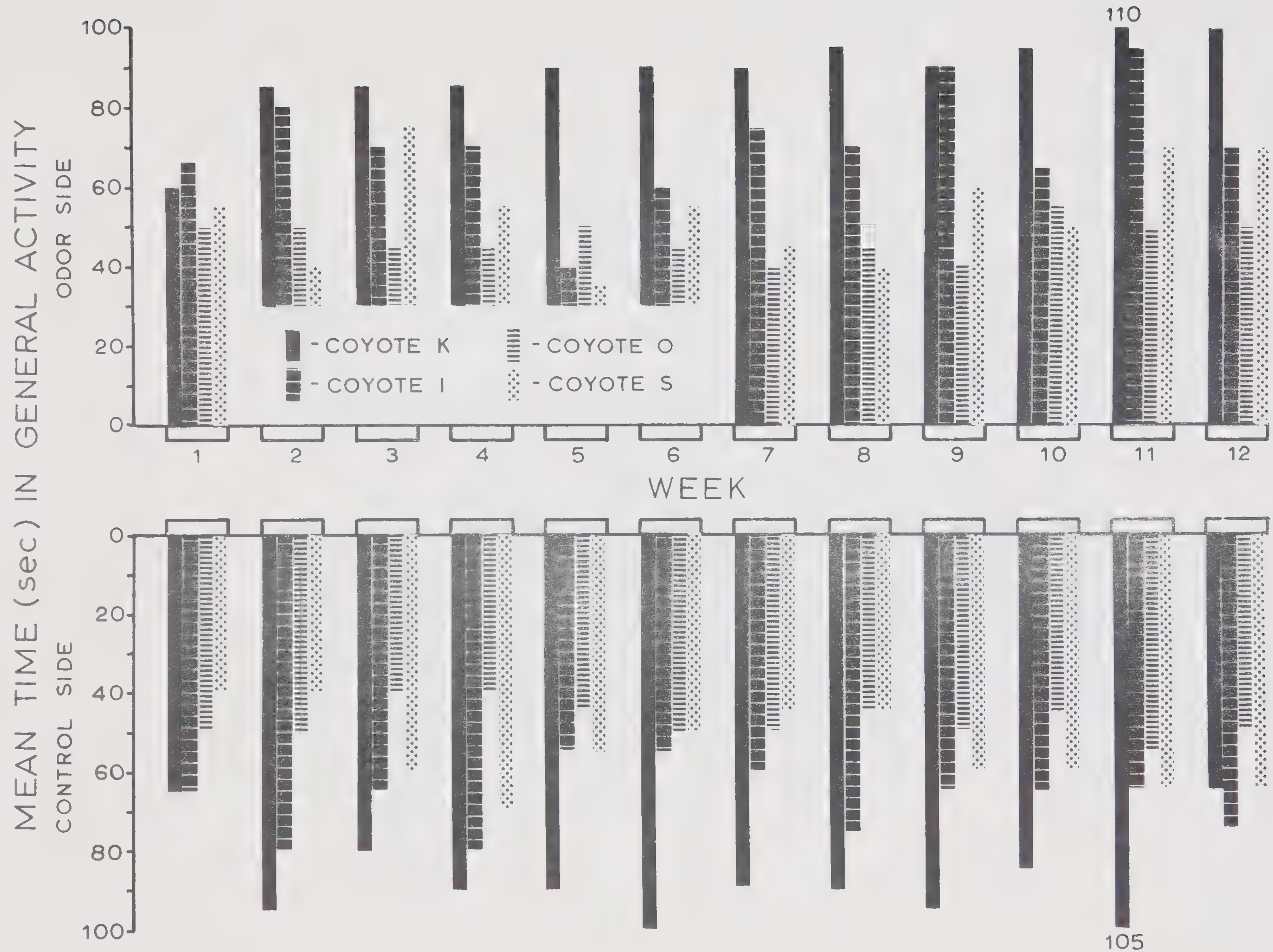

MEAN TIME (sec) IN GENERAL ACTIVITY
ODOR SIDE
CONTROL SIDE
WEEK
1
2
3
4
5
6
7
8
9
10
11
12
0
20
40
60
80
100
110
105
- COYOTE K
- COYOTE I
- COYOTE O
- COYOTE S

Fig. 16. Relationship between the test odor and the time spent in general activity that coyotes M, P, Q, and N exhibited during the "M-P-Q-N Experiment", over the period March 31 to June 11, 1971. The odors used were:

1. Urine - coyote K (N-AM1-4)
2. Feces - "
3. Urine - coyote I (N-AM2-4)
4. Feces - "
5. Urine - coyote O (N-AF3-4)
6. Feces - "
7. Urine - coyote S (N-AF4-4)
8. Feces - "
9. No odor

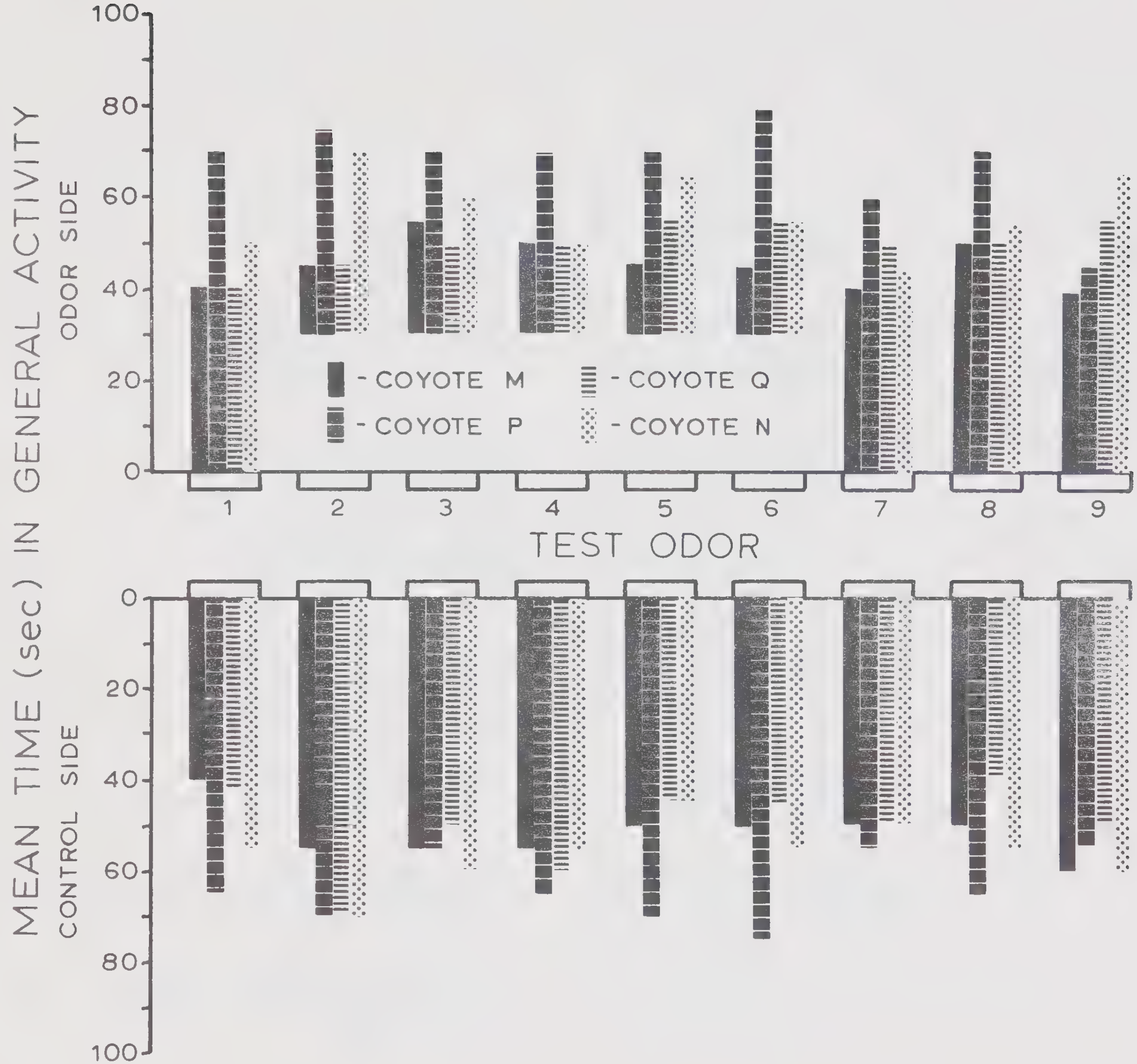
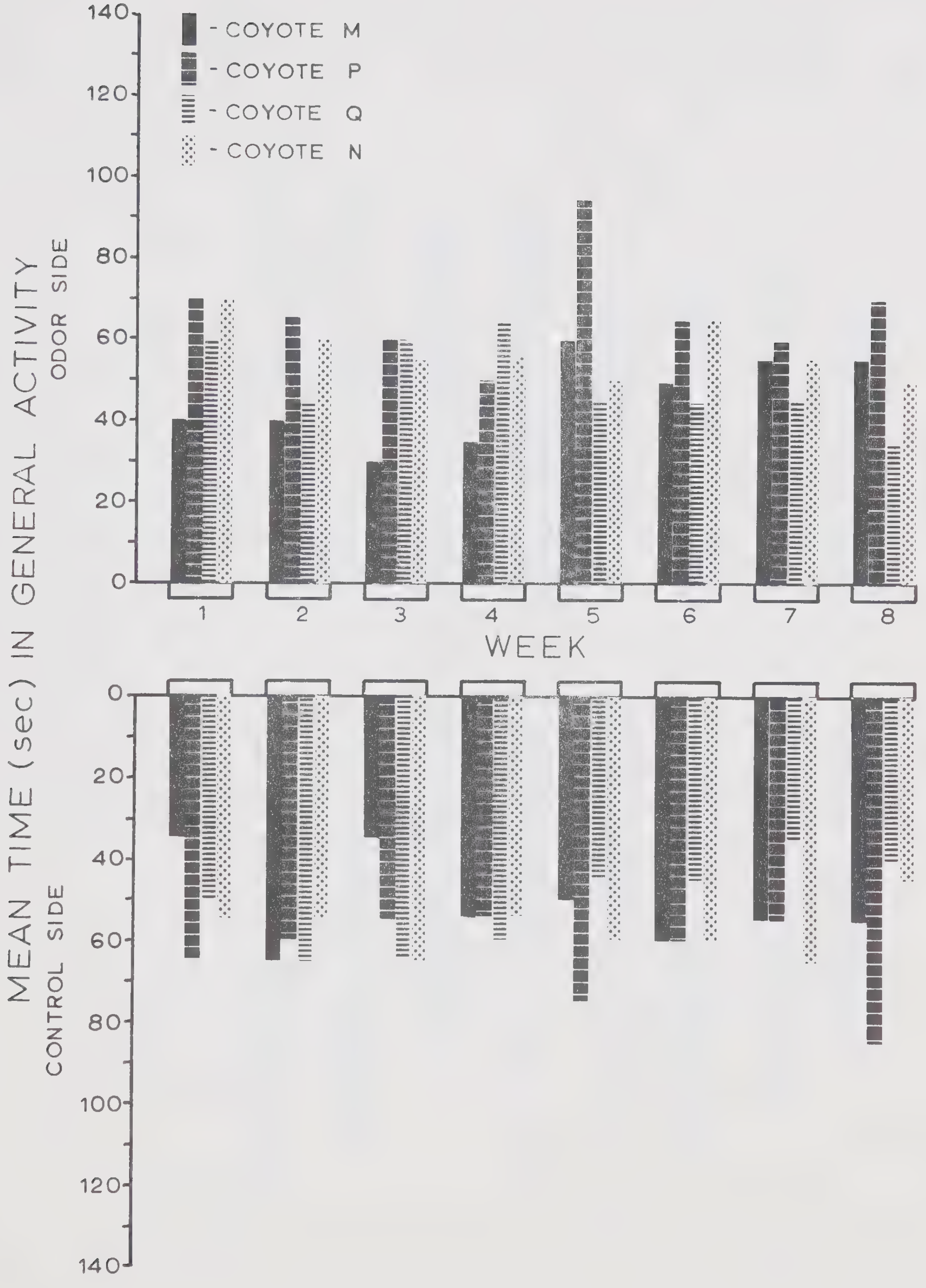
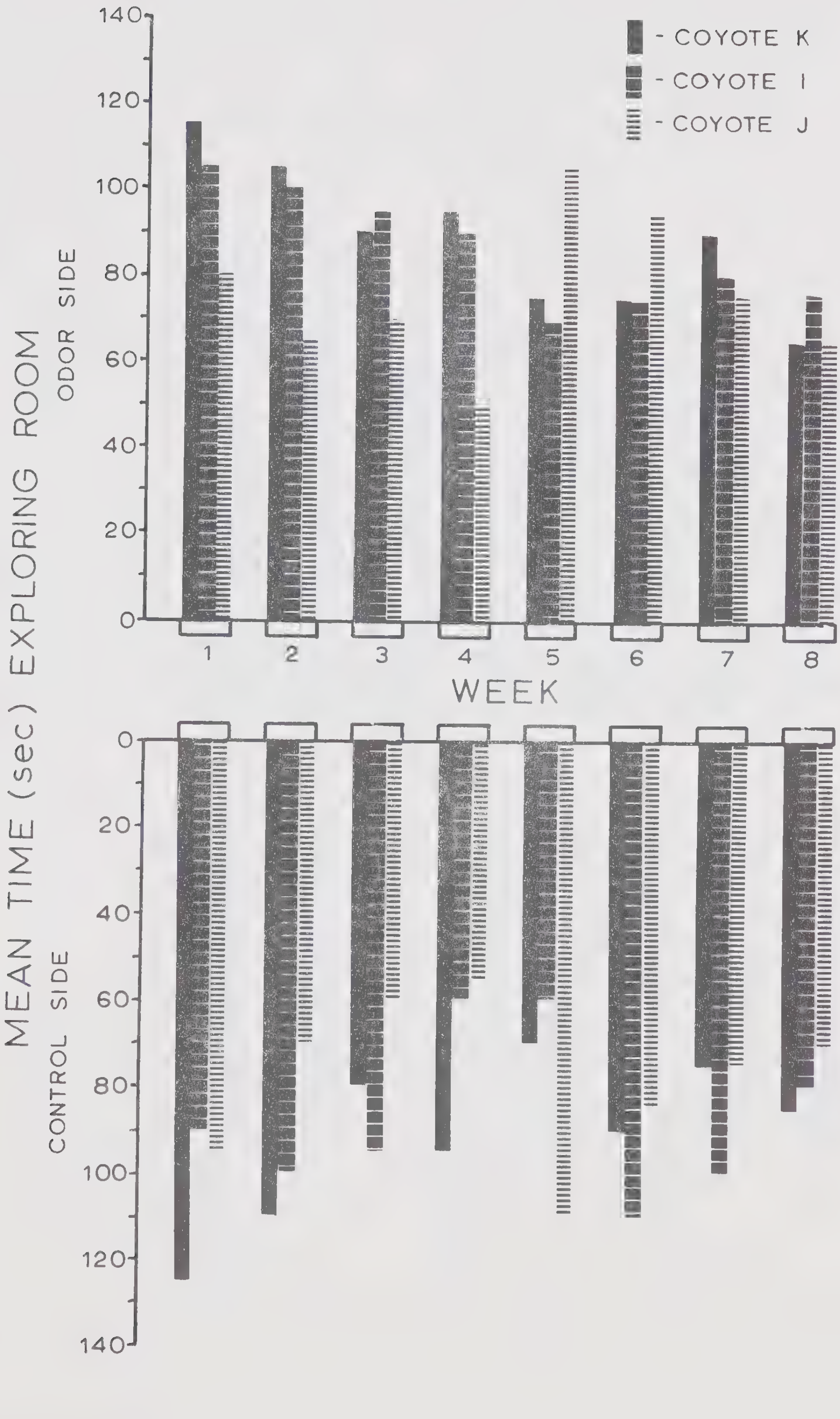

MEAN TIME (sec) IN GENERAL ACTIVITY
ODOR SIDE
CONTROL SIDE
100
80
60
40
20
0
- COYOTE M
- COYOTE P
- COYOTE Q
- COYOTE N
1
2
3
4
5
6
7
8
9
TEST ODOR

Fig. 17. Relationship between the week of the experiment and the time spent in general activity that coyotes M, P, Q, and N exhibited during the "M-P-Q-N Experiment", over the period March 31 to June 11, 1971.



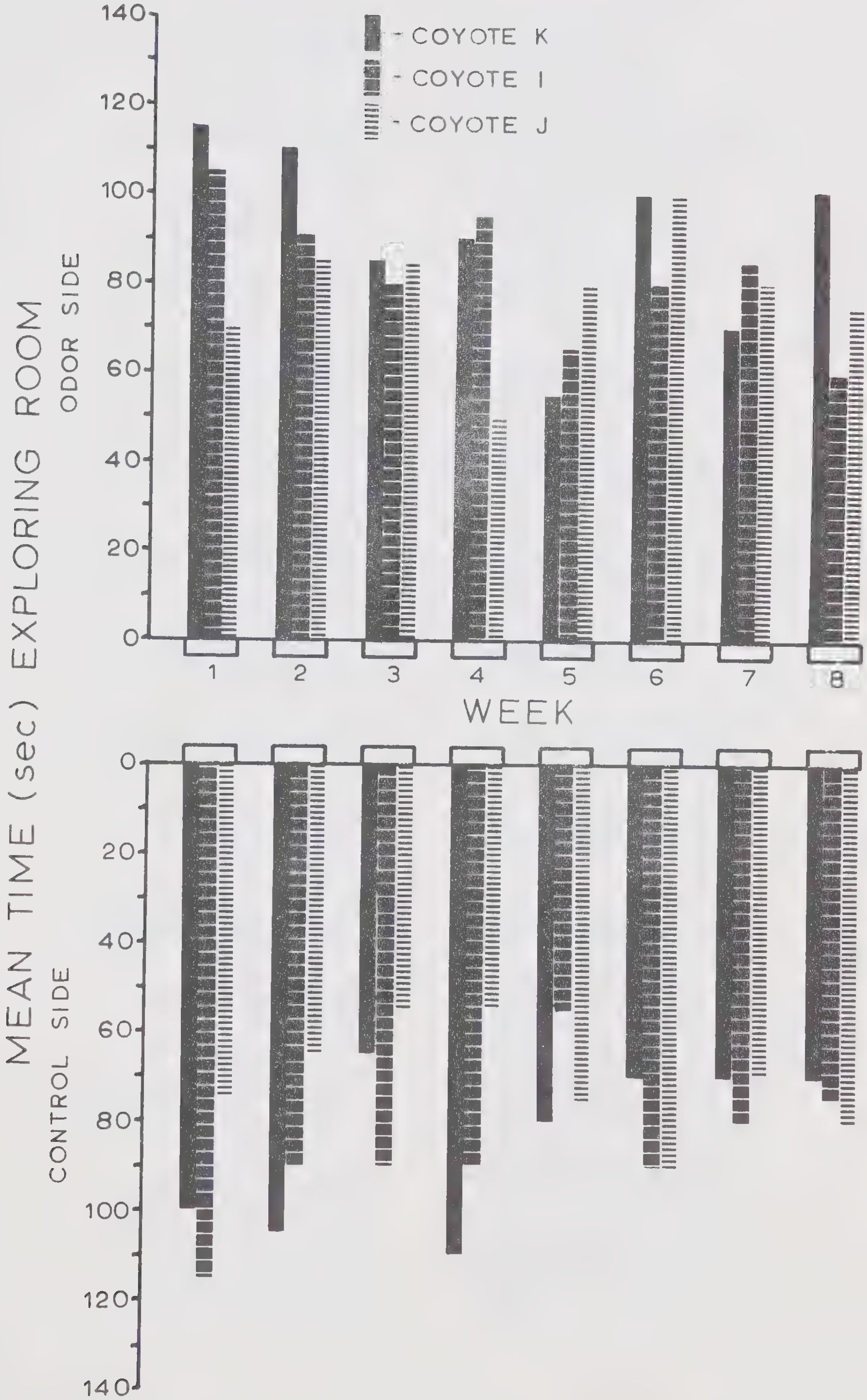
- COYOTE M
- COYOTE P
- COYOTE Q
- COYOTE N
MEAN TIME (sec) IN GENERAL ACTIVITY
ODOR SIDE
CONTROL SIDE
WEEK
140
120
100
80
60
40
20
0
1
2
3
4
5
6
7
8

Fig. 18. Relationship between the week of the experiment and the time spent in olfactory exploration of the room that coyotes K, I, and J exhibited during the "Urine Experiment", over the period June 22 to August 20, 1970.



- COYOTE K
- COYOTE I
- COYOTE J
MEAN TIME (sec) EXPLORING ROOM
ODOR SIDE
CONTROL SIDE
WEEK
1
2
3
4
5
6
7
8
0
20
40
60
80
100
120
140

Fig. 19. Relationship between the week of the experiment and the time spent in olfactory exploration of the room that coyotes K, I, and J exhibited during the "Feces Experiment", over the period June 23 to August 19, 1970.



COYOTE K
COYOTE I
COYOTE J
MEAN TIME (sec) EXPLORING ROOM
ODOR SIDE
CONTROL SIDE
WEEK
140
120
100
80
60
40
20
0
1
2
3
4
5
6
7
8

Fig. 20. Relationship between the week of the experiment and the time spent in olfactory exploration of the room that coyotes K, I, and J exhibited during the "K-I-J Experiment", over the period September 14, 1970 to February 23, 1971.

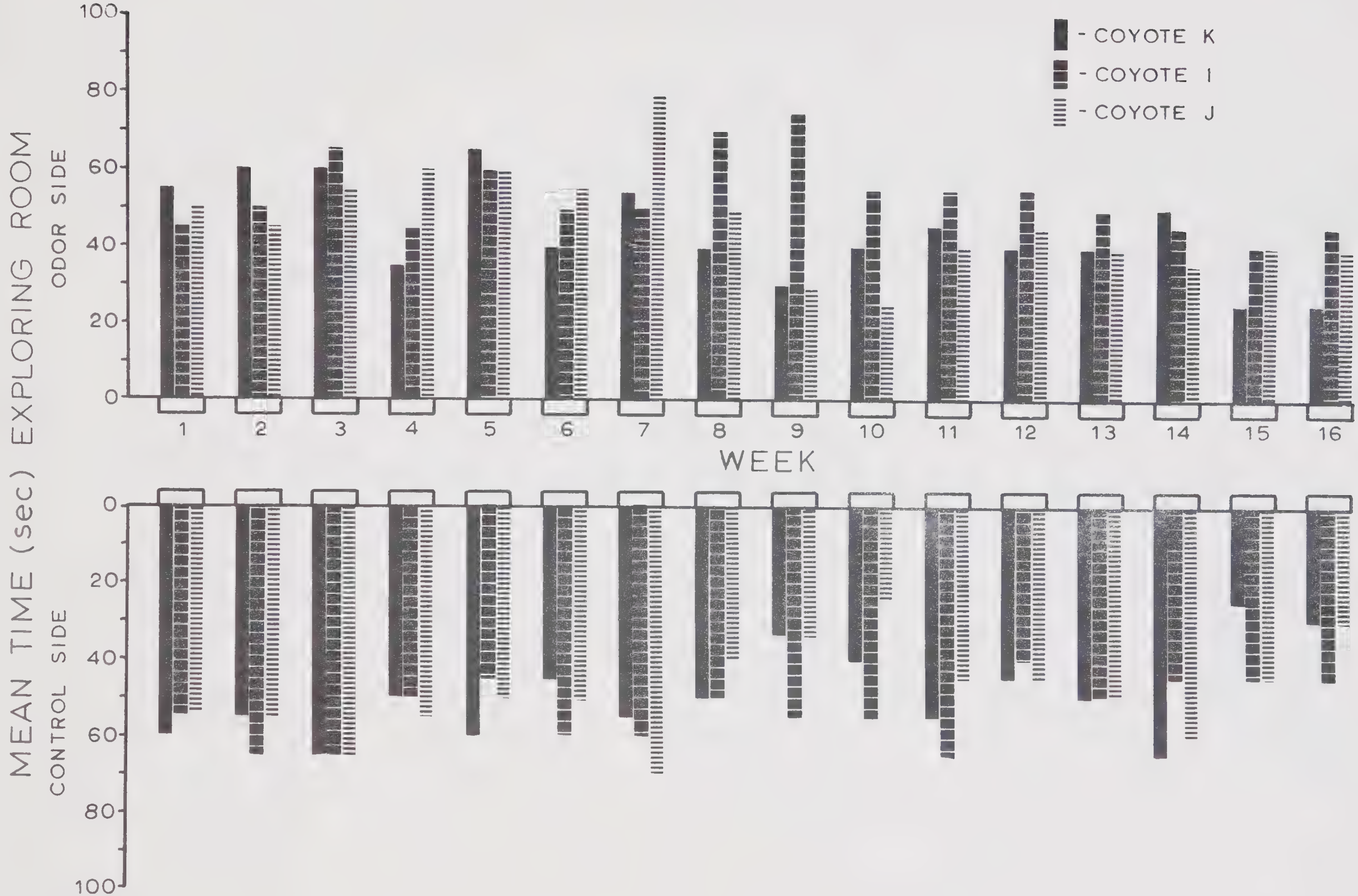
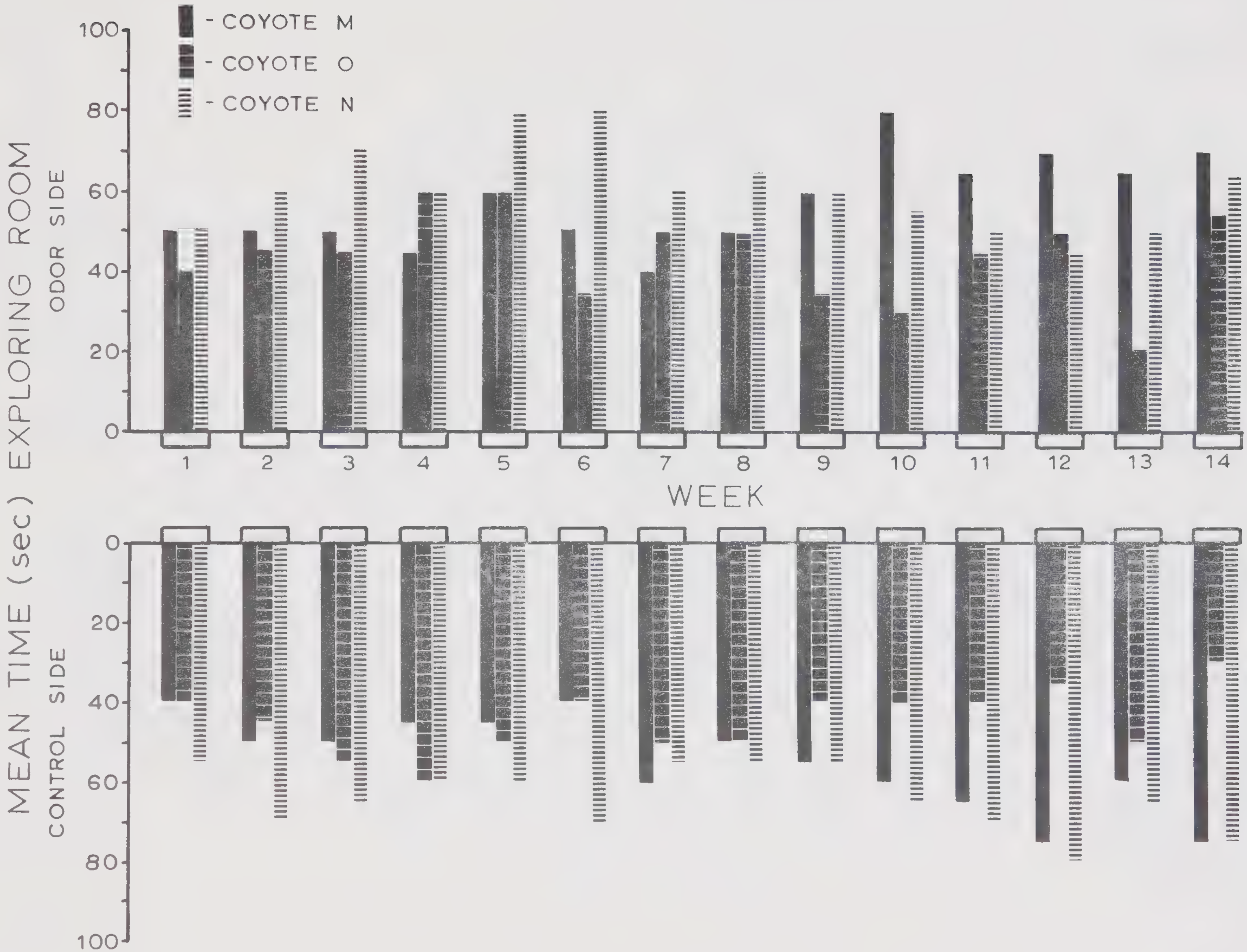
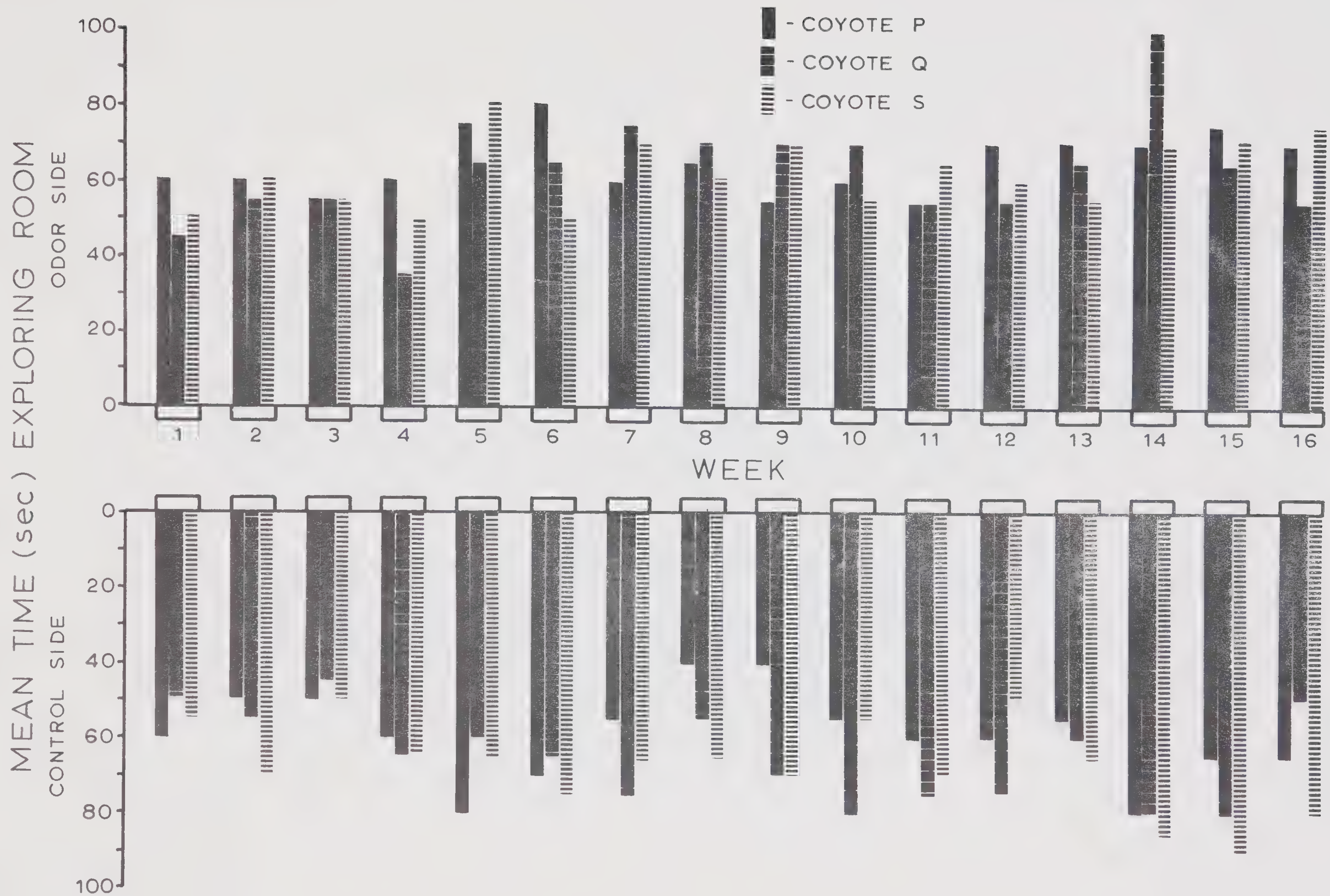

MEAN TIME (sec) EXPLORING ROOM
ODOR SIDE
CONTROL SIDE
WEEK
- COYOTE K
- COYOTE I
- COYOTE J
100
80
60
40
20
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16

Fig. 21. Relationship between the week of the experiment and the time spent in olfactory exploration of the room that coyotes M, O, and N exhibited during the "M-O-N Experiment", over the period September 15, 1970 to February 3, 1971.



- COYOTE M
- COYOTE O
- COYOTE N
MEAN TIME (sec) EXPLORING ROOM
ODOR SIDE
CONTROL SIDE
WEEK
100
80
60
40
20
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14

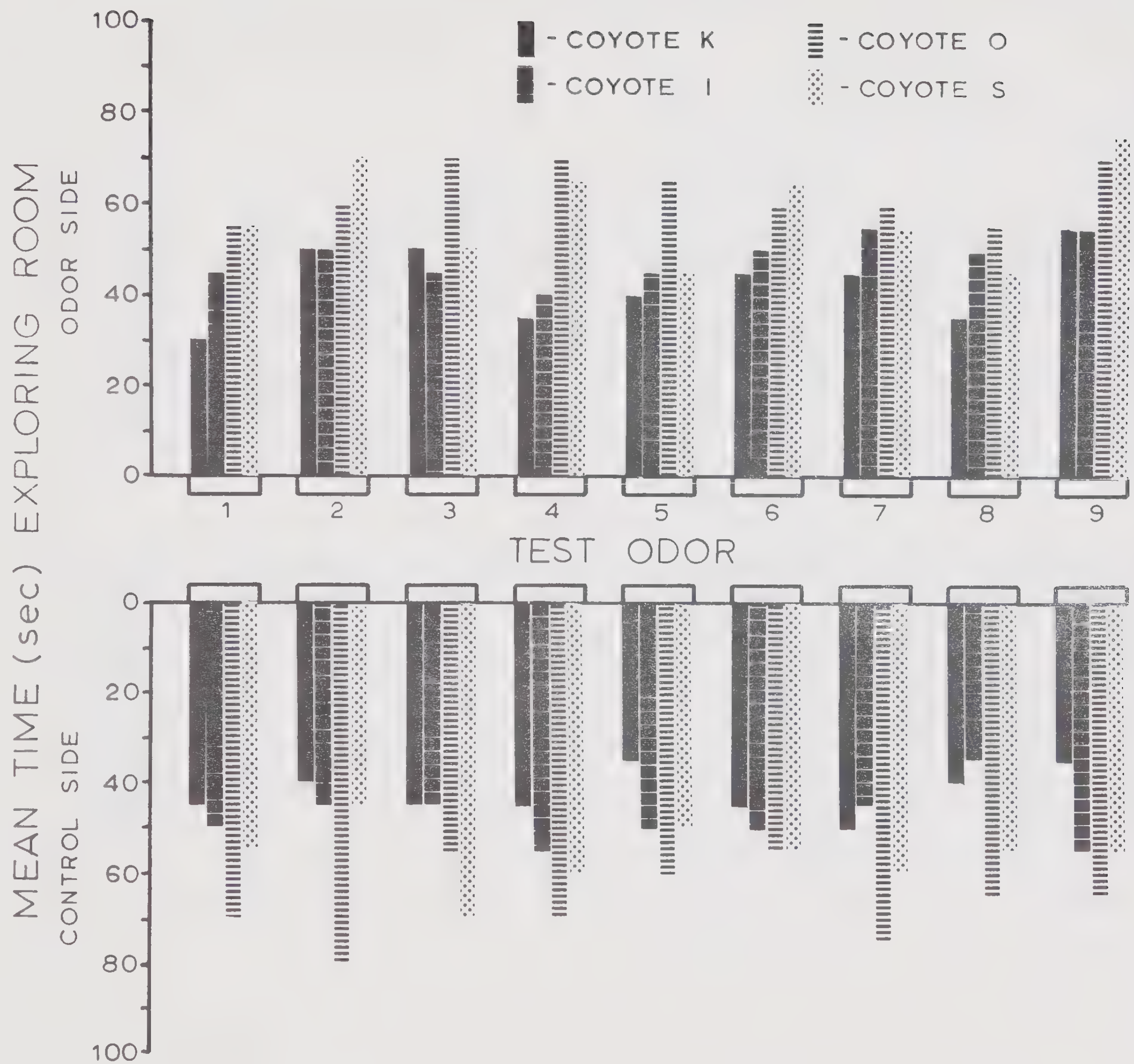
Fig. 22. Relationship between the week of the experiment and the time spent in olfactory exploration of the room that coyotes P, Q, and S exhibited during the "P-Q-S Experiment", over the period September 16, 1970 to February 25, 1971.



- COYOTE P
- COYOTE Q
- COYOTE S
MEAN TIME (sec) EXPLORING ROOM
ODOR SIDE
CONTROL SIDE
WEEK
100
80
60
40
20
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16

Fig. 23. Relationship between the test odor and the time spent in olfactory exploration of the room that coyotes K, I, O, and S exhibited during the "K-I-O-S Experiment", over the period March 30 to July 22, 1971. The odors used were:

1. Urine - coyote M (N-JM1-4)
2. Feces - "
3. Urine - coyote P (N-JM2-4)
4. Feces - "
5. Urine - coyote Q (N-AF3-4)
6. Feces - "
7. Urine - coyote N (N-AF4-4)
8. Feces - "
9. No odor



- COYOTE K
- COYOTE I
- COYOTE O
- COYOTE S
MEAN TIME (sec) EXPLORING ROOM
ODOR SIDE
CONTROL SIDE
TEST ODOR
0
20
40
60
80
100
1
2
3
4
5
6
7
8
9

Fig. 24. Relationship between the week of the experiment and the time spent in olfactory exploration of the room that coyotes K, I, O, and S exhibited during the "K-I-O-S Experiment", over the period March 30 to July 22, 1971.

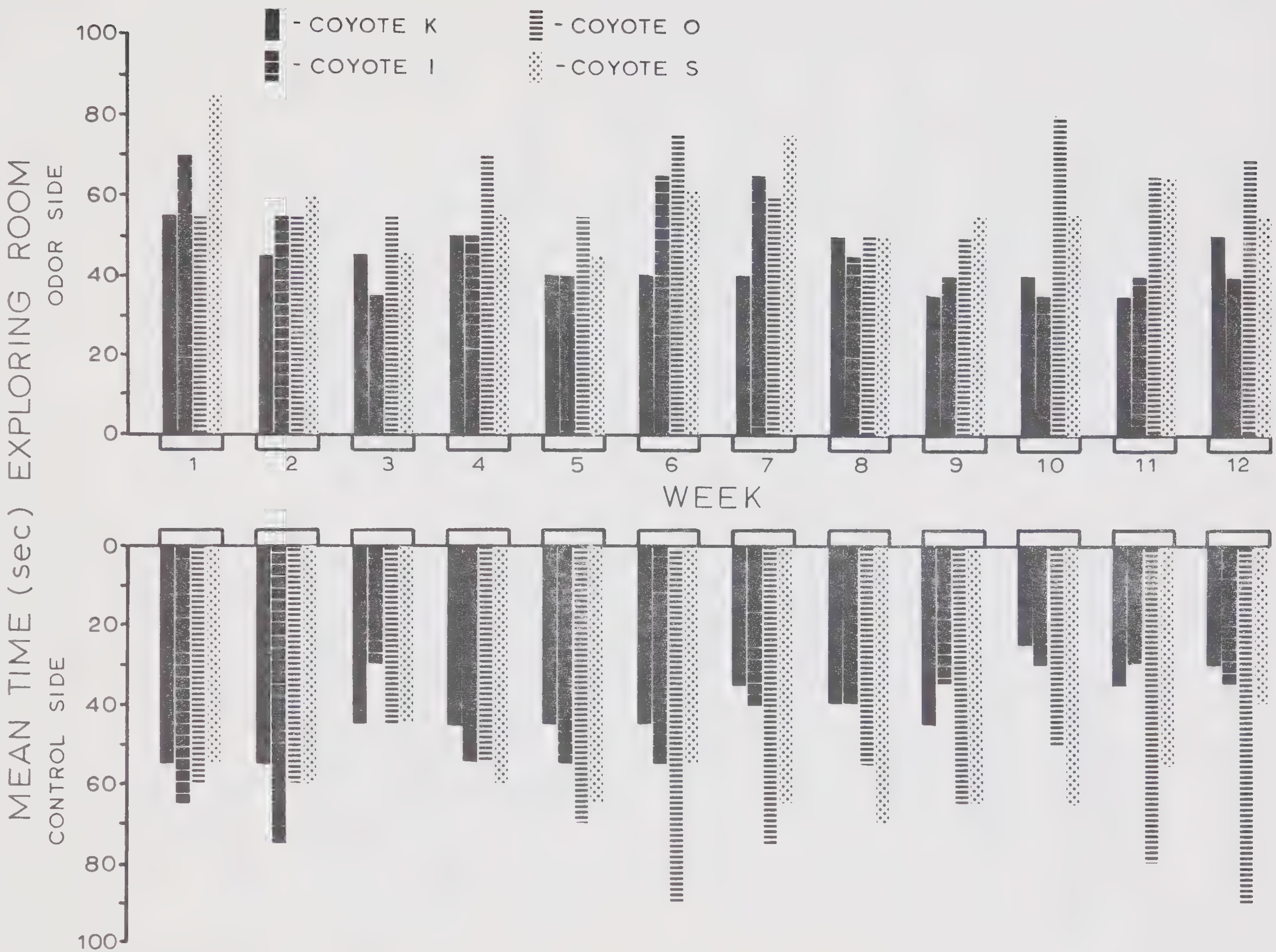
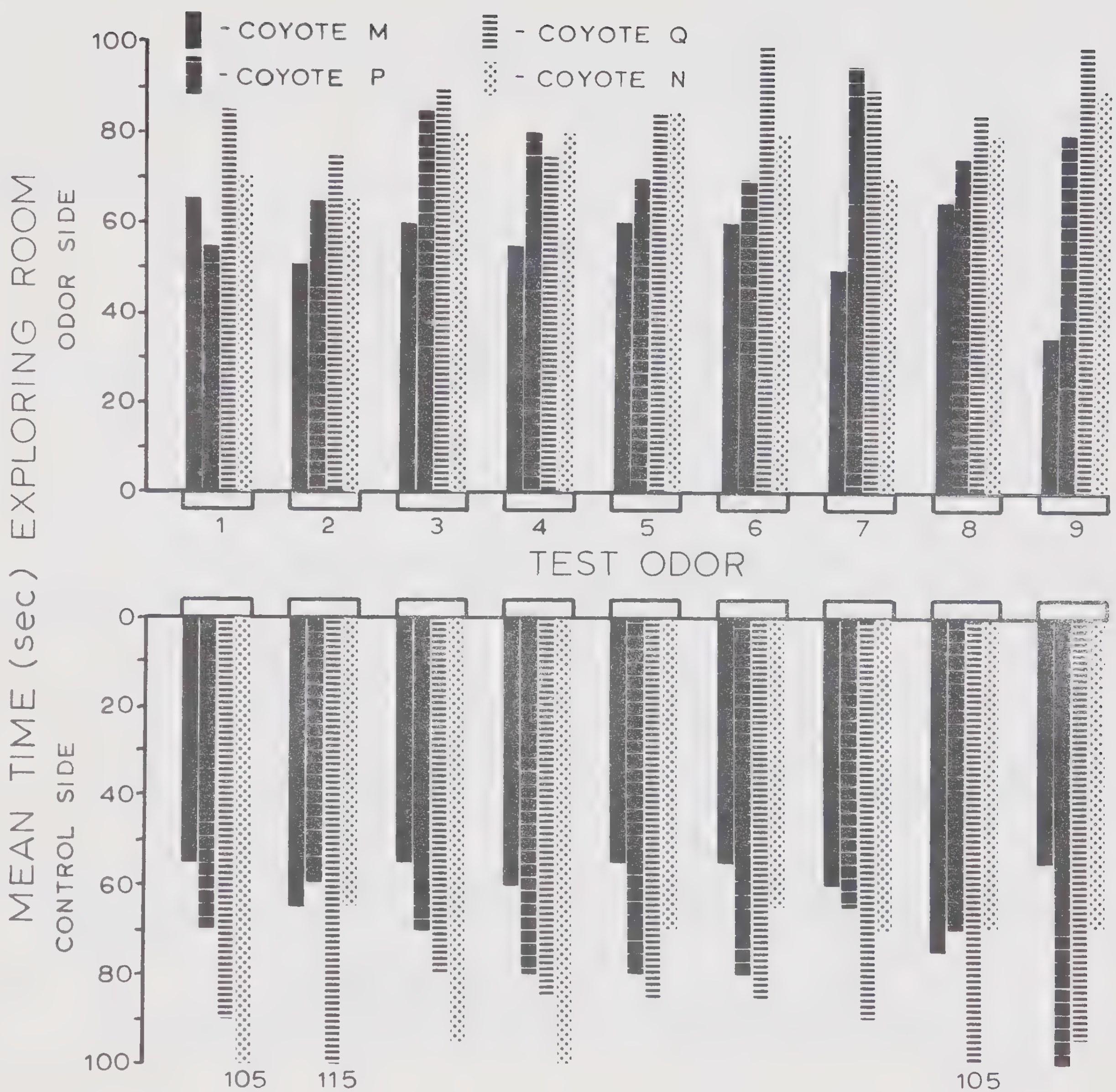

- COYOTE K
- COYOTE I
- COYOTE O
- COYOTE S
MEAN TIME (sec) EXPLORING ROOM
ODOR SIDE
CONTROL SIDE
WEEK
100
80
60
40
20
0
1
2
3
4
5
6
7
8
9
10
11
12

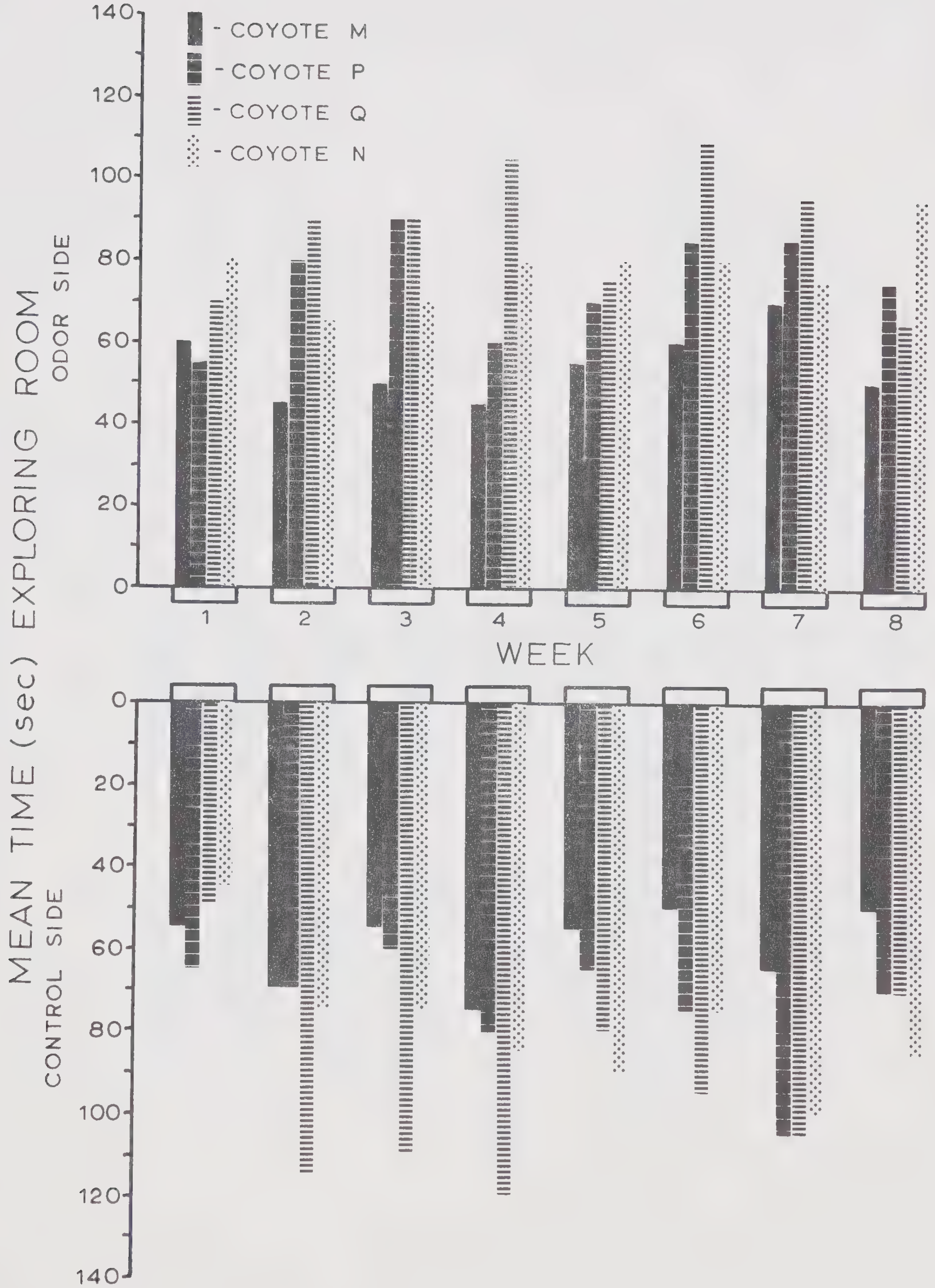
Fig. 25. Relationship between the test odor and the time spent in olfactory exploration of the room that coyotes M, P, Q, and N exhibited during the "M-P-Q-N Experiment", over the period March 31 to June 11, 1971. The odors used were:

1. Urine - coyote K (N-AM1-4)
2. Feces - "
3. Urine - coyote I (N-AM2-4)
4. Feces - "
5. Urine - coyote O (N-AF3-4)
6. Feces - "
7. Urine - coyote S (N-AF4-4)
8. Feces - "
9. No odor



- COYOTE M
- COYOTE P
- COYOTE Q
- COYOTE N
MEAN TIME (sec) EXPLORING ROOM
ODOR SIDE
CONTROL SIDE
TEST ODOR
0
20
40
60
80
100
1
2
3
4
5
6
7
8
9
105
115
105

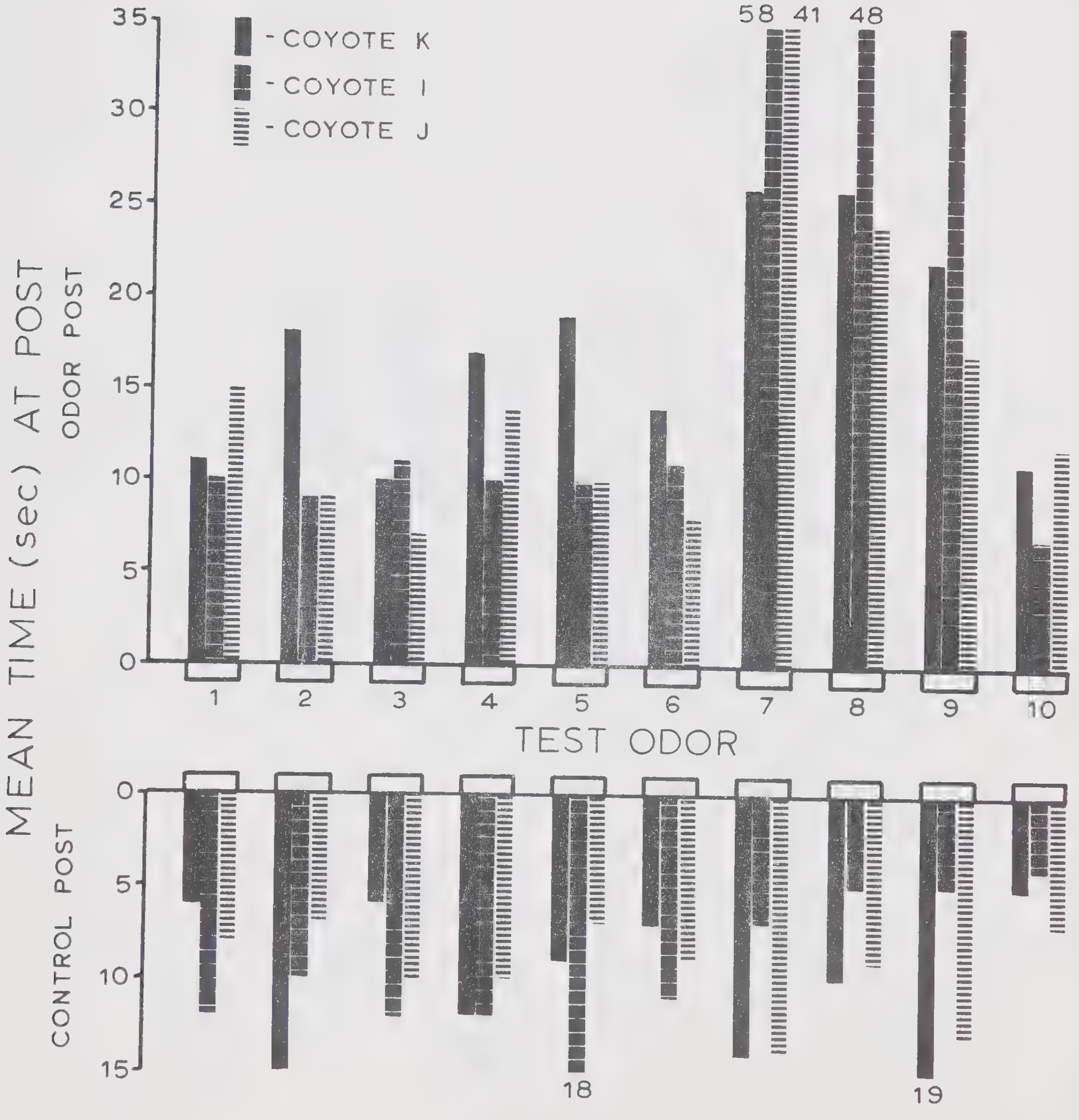
Fig. 26. Relationship between the week of the experiment and the time spent in olfactory exploration of the room that coyotes M, P, Q, and N exhibited during the "M-P-Q-N Experiment", over the period March 31 to June 11, 1971.



COYOTE M
COYOTE P
COYOTE Q
COYOTE N
MEAN TIME (sec) EXPLORING ROOM
ODOR SIDE
CONTROL SIDE
WEEK
0
20
40
60
80
100
120
140
1
2
3
4
5
6
7
8

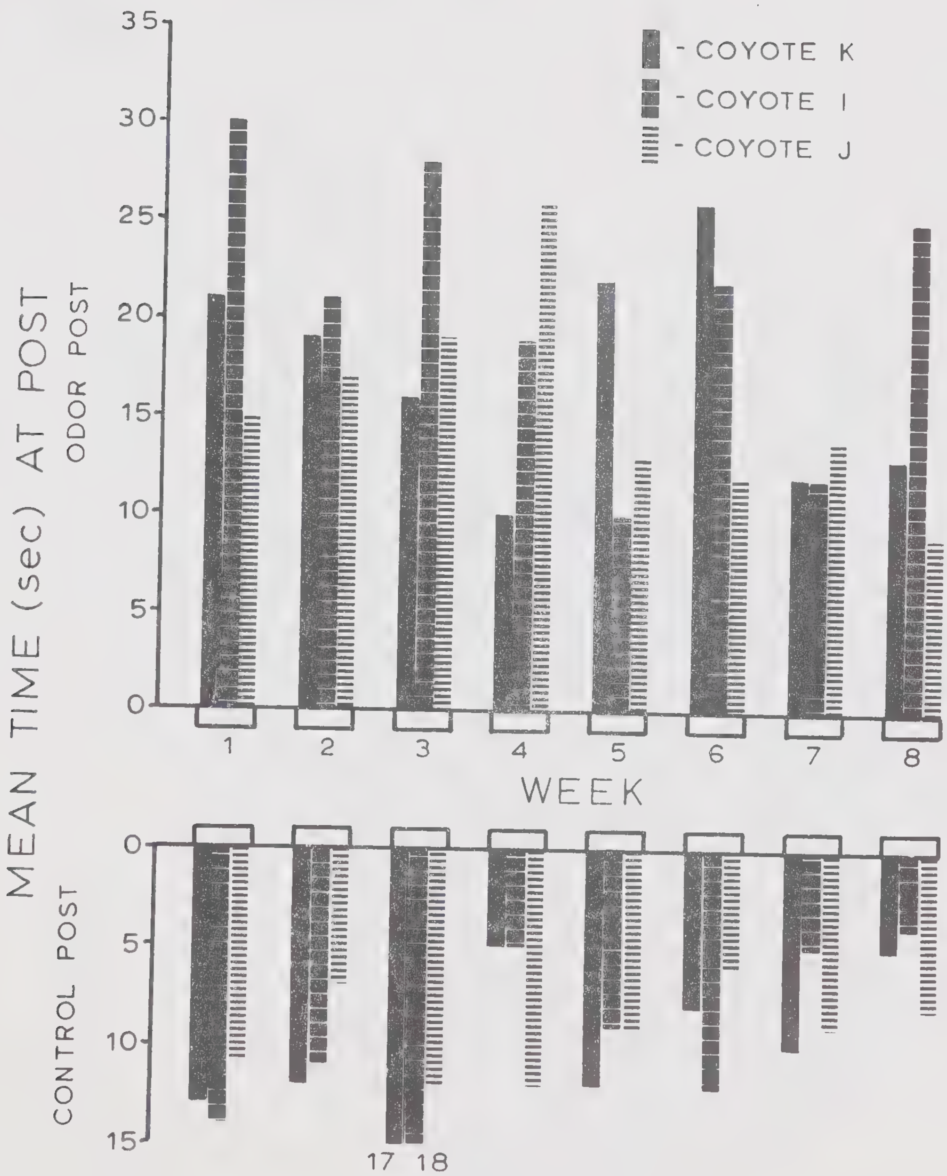
Fig. 27. Relationship between the test odor and the total time that coyotes K, I, and J spent at the posts during the "Urine Experiment", over the period June 22 to August 20, 1970. The odors used were urine from:

1. Coyote K (G-AM1-3)
2. Coyote I (G-AM2-3)
3. Coyote J (G-AM3-3)
4. Coyote M (N-PM1-3)
5. Coyote O (N-PF2-3)
6. Coyote N (N-PF3-3)
7. Male domestic dog
8. Female domestic dog (anestrus)
9. Female domestic dog (estrus)
10. No odor



- COYOTE K
- COYOTE I
- COYOTE J
58
41
48
18
19
MEAN TIME (sec) AT POST
ODOR POST
CONTROL POST
TEST ODOR
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
8
9
10

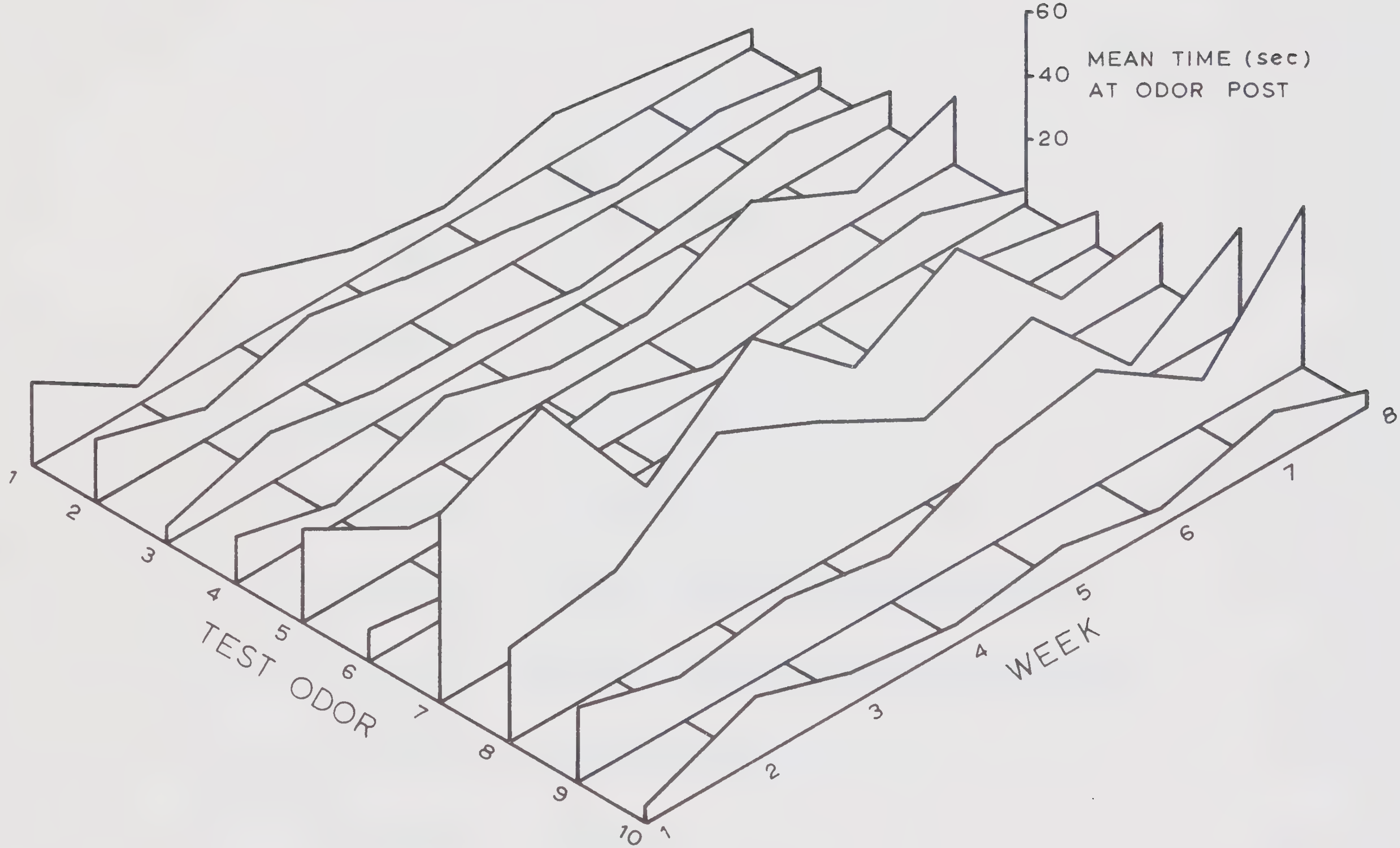
Fig. 28. Relationship between the week of the experiment and the total time that coyotes K, I, and J spent at the posts during the "Urine Experiment", over the period June 22 to August 20, 1970.



- COYOTE K
- COYOTE I
- COYOTE J
MEAN TIME (sec) AT POST
ODOR POST
CONTROL POST
WEEK
1
2
3
4
5
6
7
8
0
5
10
15
20
25
30
35
17
18

Fig. 29. Relationship between the test odor and the week of the experiment, in relation to the total time that coyotes K, I, and J spent at the odor post during the "Urine Experiment", over the period June 22 to August 20, 1971. The odors used were urine from:

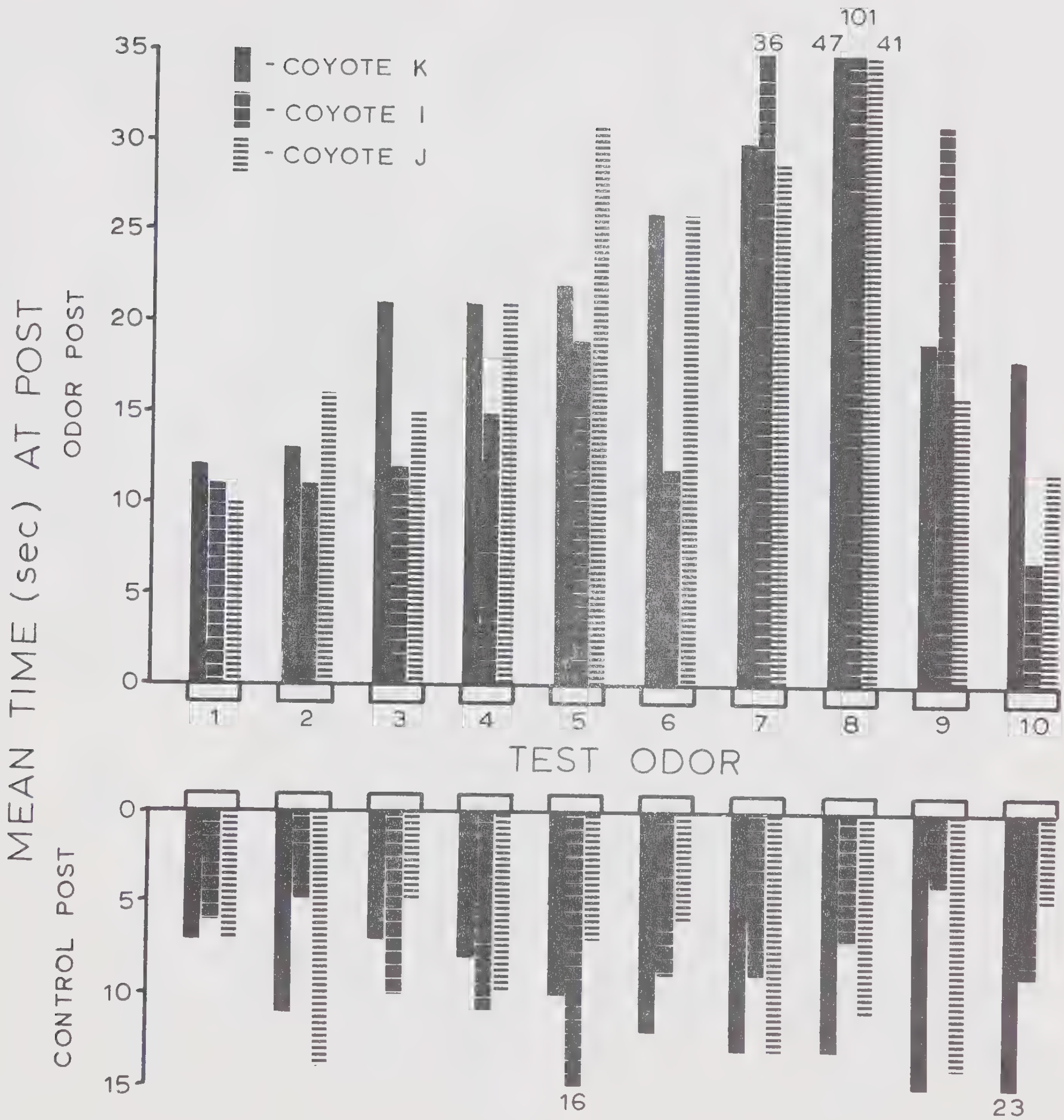
1. Coyote K (G-AM1-3)
2. Coyote I (G-AM2-3)
3. Coyote J (G-AM3-3)
4. Coyote M (N-PM1-3)
5. Coyote O (N-PF2-3)
6. Coyote N (N-PF3-3)
7. Male domestic dog
8. Female domestic dog (anestrus)
9. Female domestic dog (estrus)
10. No odor



60
40
20
MEAN TIME (sec)
AT ODOR POST
TEST ODOR
1
2
3
4
5
6
7
8
9
10
WEEK
1
2
3
4
5
6
7
8

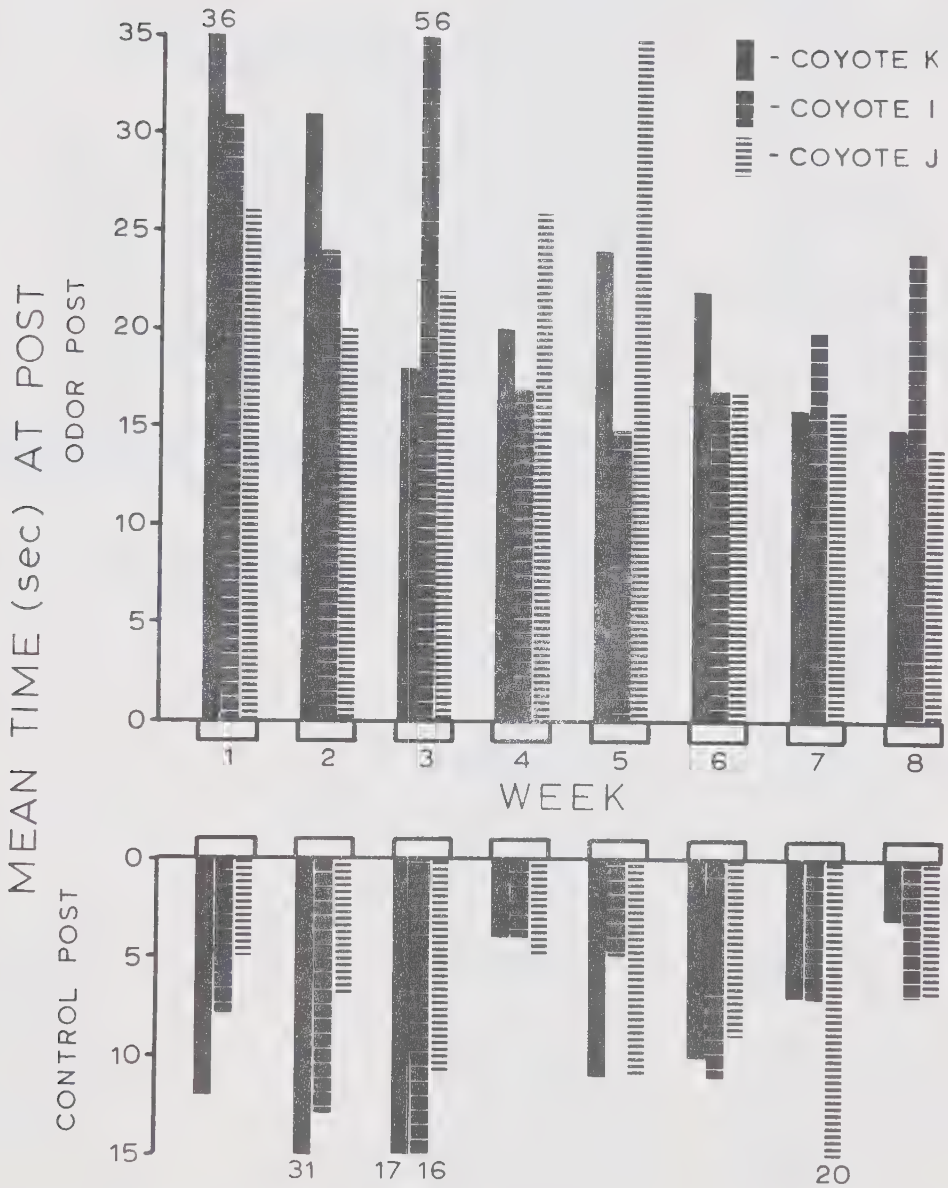
Fig. 30. Relationship between the test odor and the total time that coyotes K, I, and J spent at the posts during the "Feces Experiment", over the period June 23 to August 19, 1970. The odors used were feces from:

1. Coyote K (G-AM1-3)
2. Coyote I (G-AM2-3)
3. Coyote J (G-AM3-3)
4. Coyote M (N-PM1-3)
5. Coyote O (N-PF2-3)
6. Coyote N (N-PF3-3)
7. Male domestic dog
8. Female domestic dog (anestrus)
9. Female doemstic dog (estrus)
10. No odor



MEAN TIME (sec) AT POST
ODOR POST
CONTROL POST
- COYOTE K
- COYOTE I
- COYOTE J
TEST ODOR
0
5
10
15
20
25
30
35
1
2
3
4
5
6
7
8
9
10
36
47
101
41
16
23

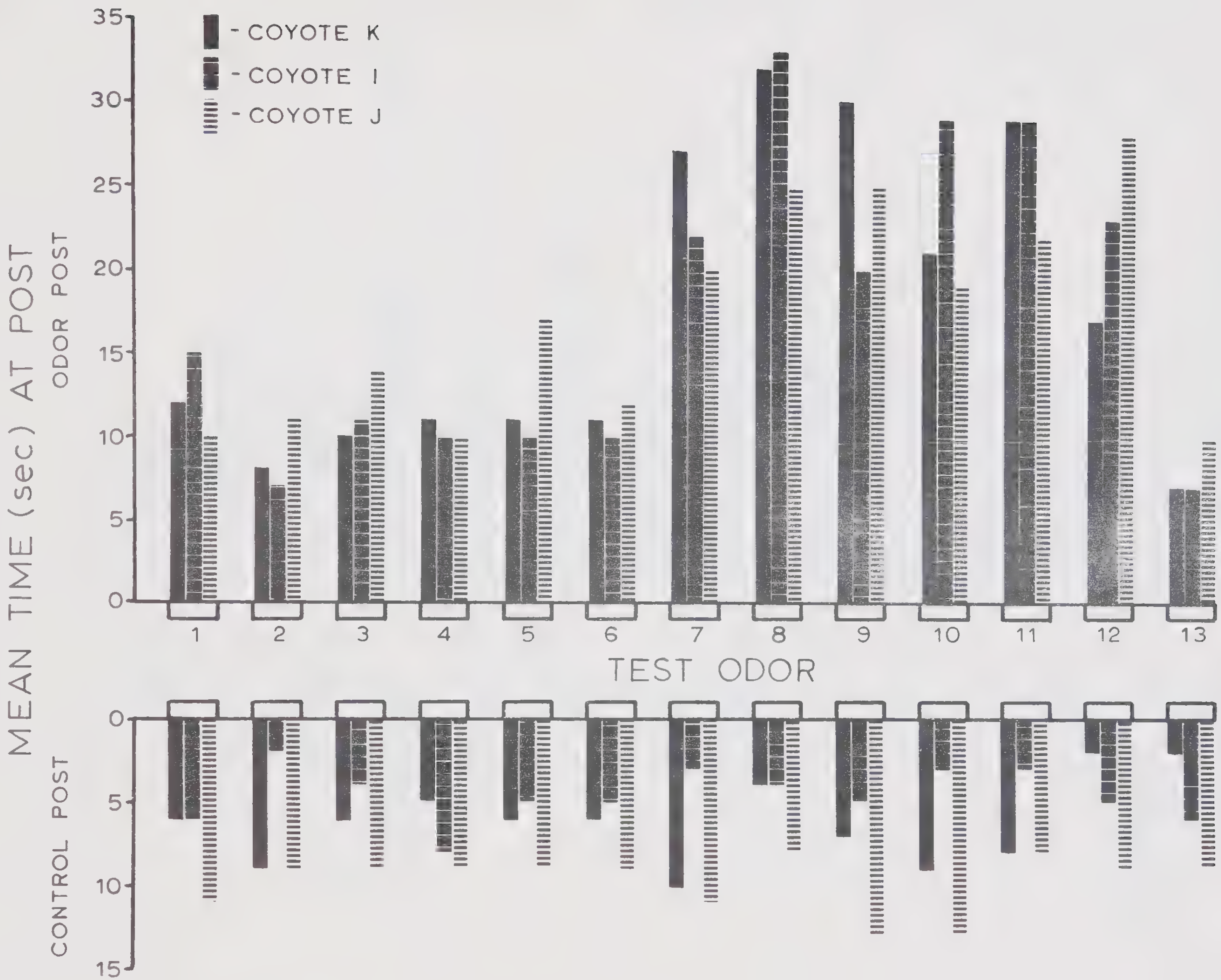
Fig. 31. Relationship between the week of the experiment and the total time that coyotes K, I, and J spent at the posts during the "Feces Experiment", over the period June 23 to August 19, 1970.



MEAN TIME (sec) AT POST
ODOR POST
CONTROL POST
WEEK
- COYOTE K
- COYOTE I
- COYOTE J
36
56
31
17
16
20

Fig. 32. Relationship between the test odor and the total time that coyotes K, I, and J spent at the posts during the "K-I-J Experiment", over the period September 14, 1970 to February 23, 1971. The odors used were:

1. Urine - coyote K (G-AM1-3)
2. Feces - "
3. Urine - coyote I (G-AM2-3)
4. Feces - "
5. Urine - coyote J (G-AM3-3)
6. Feces - "
7. Urine - male domestic dog
8. Feces - "
9. Urine - female domestic dog (anestrus)
10. Feces - "
11. Urine - female domestic dog (estrus)
12. Feces - "
13. No odor



MEAN TIME (sec) AT POST
ODOR POST
CONTROL POST
- COYOTE K
- COYOTE I
- COYOTE J
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
8
9
10
11
12
13
TEST ODOR
0
5
10
15

Fig. 33. Relationship between the week of the experiment and the total time that coyotes K, I, and J spent at the posts during the "K-I-J Experiment", over the period September 14, 1970 to February 23, 1971.

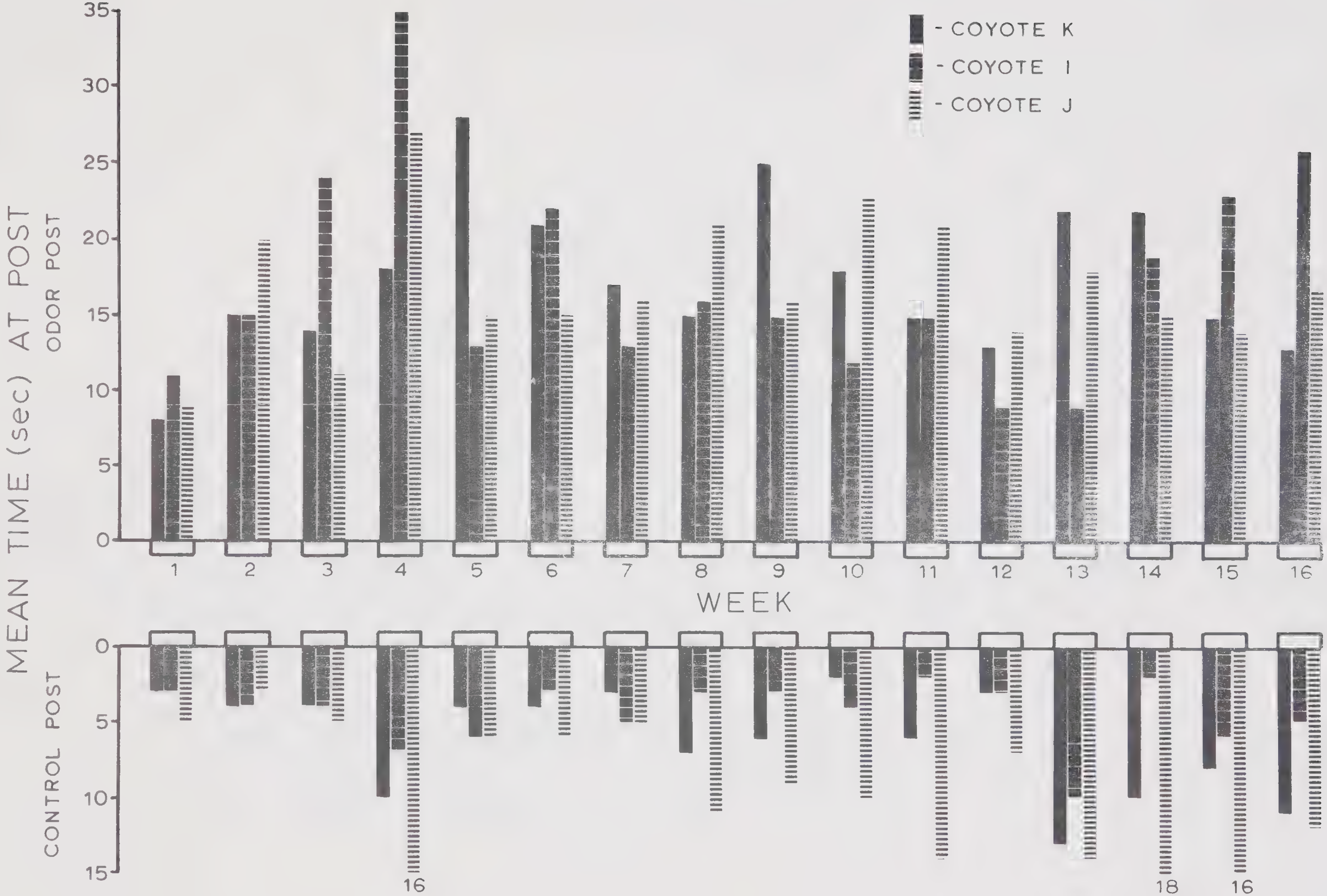

- COYOTE K
- COYOTE I
- COYOTE J
MEAN TIME (sec) AT POST
ODOR POST
CONTROL POST
WEEK
16
18
16

Fig. 34. Relationship between the test odor and the week of the experiment, in relation to the total time that coyotes K, I, and J spent at the odor post during the "K-I-J Experiment, over the period September 14, 1970 to February 23, 1971. The odors used were:

1. Urine - coyote K (G-AM1-3)
2. Feces - "
3. Urine - coyote I (G-AM2-3)
4. Feces - "
5. Urine - coyote J (G-AM3-3)
6. Feces - "
7. Urine - male domestic dog
8. Feces - "
9. Urine - female domestic dog (anestrus)
10. Feces - "
11. Urine - female domestic dog (estrus)
12. Feces - "
13. No odor

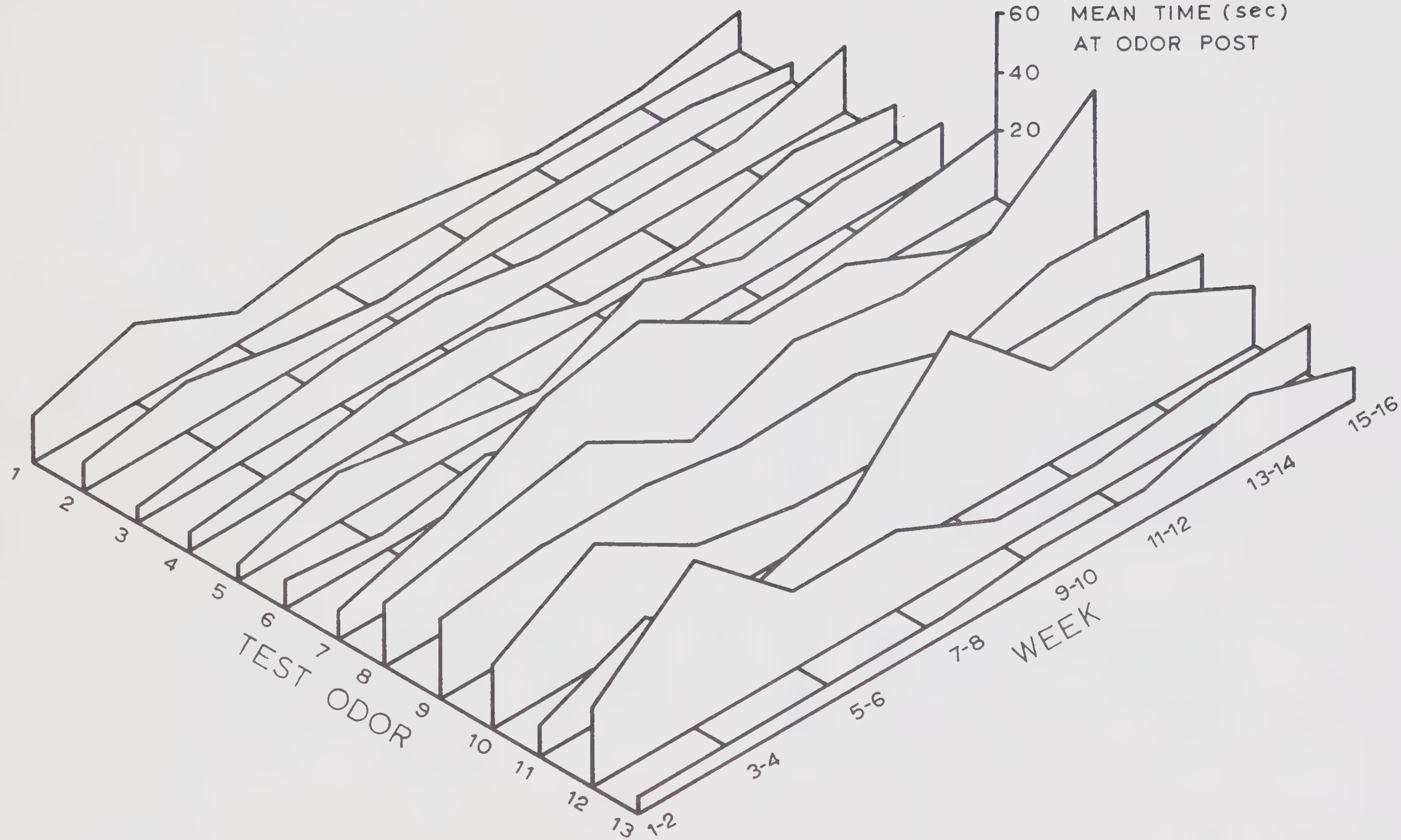

60
40
20
MEAN TIME (sec)
AT ODOR POST
1
2
3
4
5
6
7
8
9
10
11
12
13
TEST ODOR
1-2
3-4
5-6
7-8
9-10
11-12
13-14
15-16
WEEK

Fig. 35. Relationship between the test odor and the total time that coyotes M, O, and N spent at the posts during the "M-O-N Experiment", over the period September 15, 1970 to February 3, 1971. The odors used were:

1. Urine - coyote M (G-JM1-3)
2. Feces - "
3. Urine - coyote O (G-JF2-3)
4. Feces - "
5. Urine - coyote N (G-JF3-3)
6. Feces - "
7. Urine - coyote P (N-JM1-3)
8. Feces - "
9. Urine - coyote Q (N-JF2-3)
10. Feces - "
11. Urine - coyote S (N-JF3-3)
12. Feces - "
13. No odor

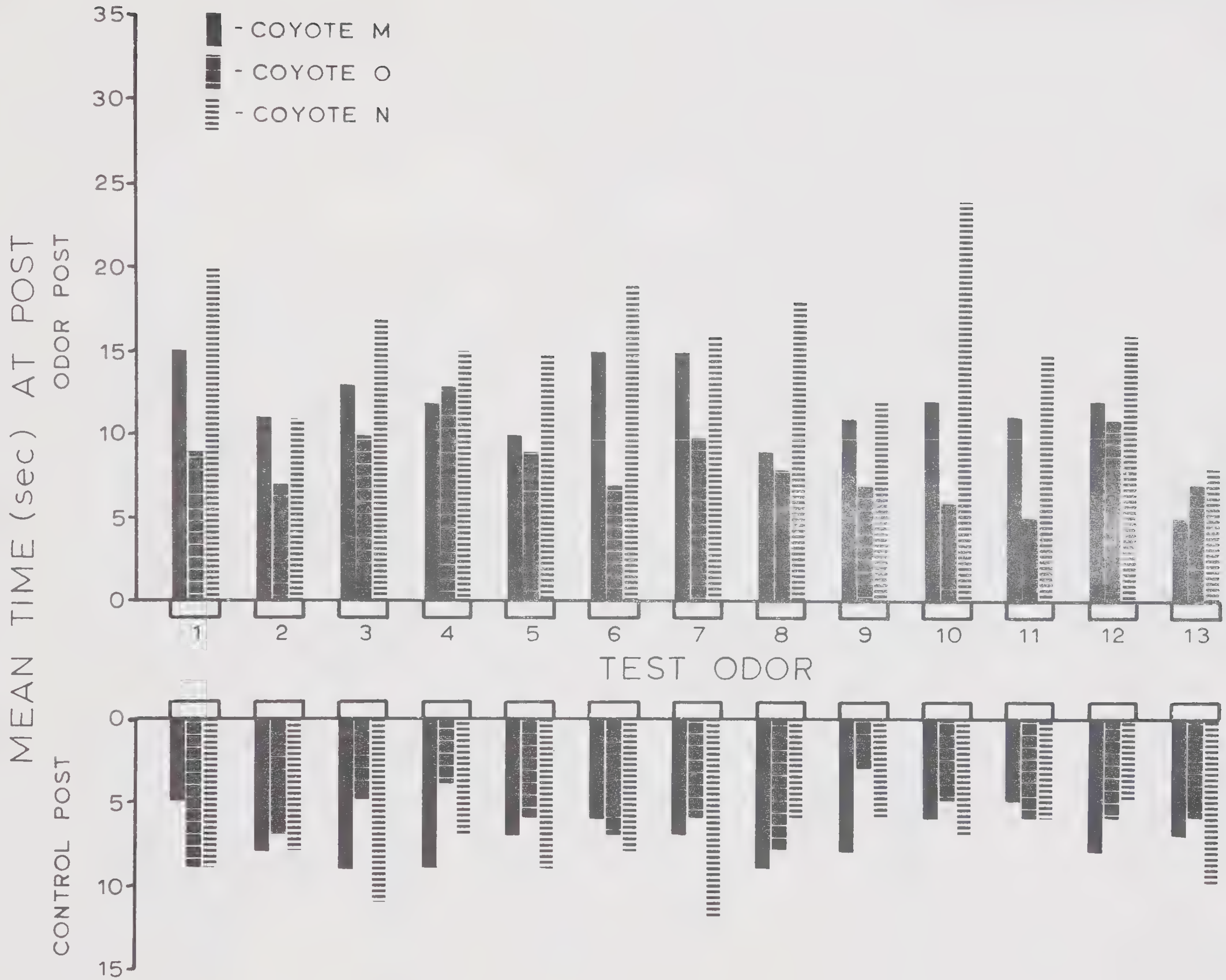
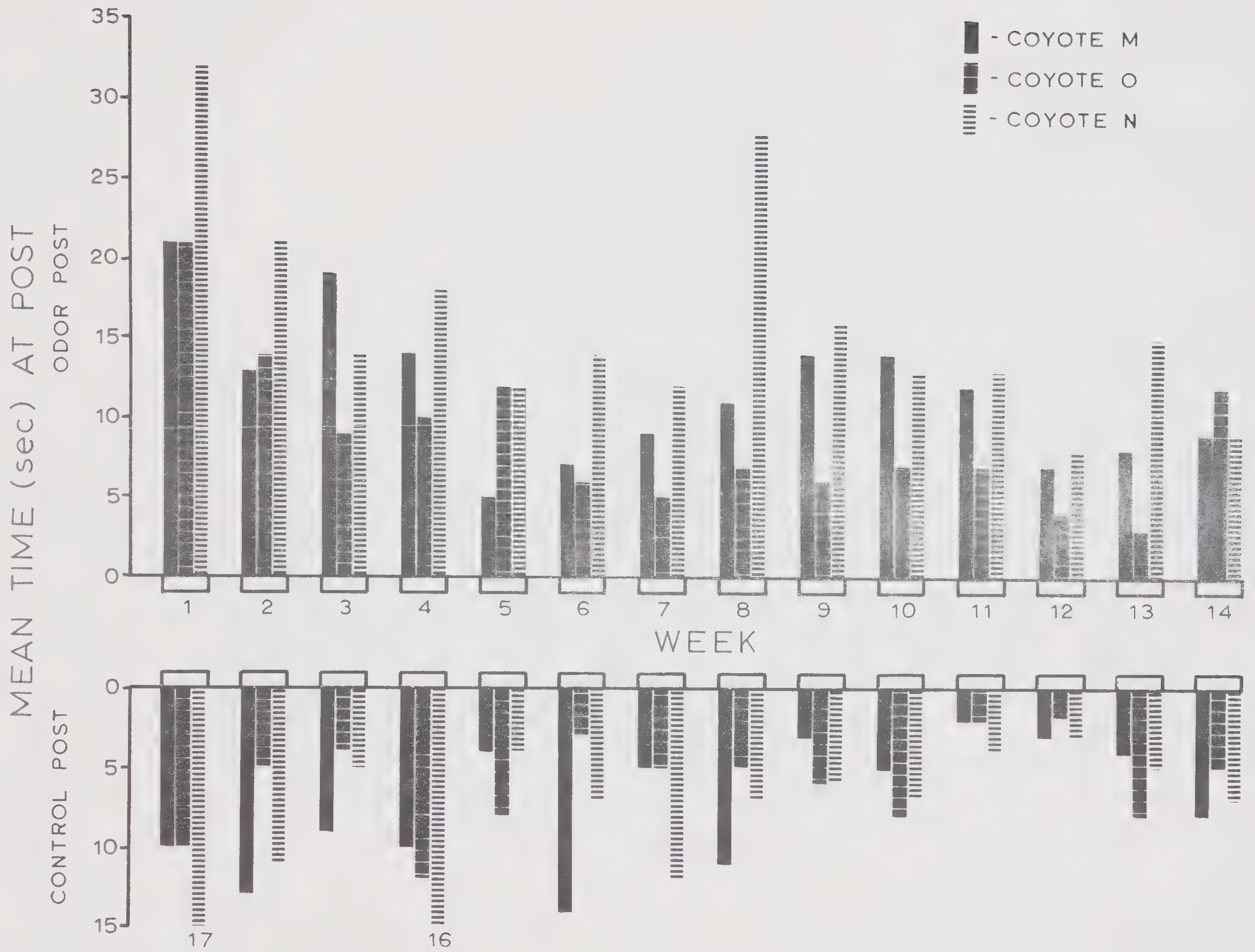

- COYOTE M
- COYOTE O
- COYOTE N
MEAN TIME (sec) AT POST
ODOR POST
CONTROL POST
TEST ODOR
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
8
9
10
11
12
13

Fig. 36. Relationship between the week of the experiment and the total time that coyotes M, O, and N spent at the posts during the "M-O-N Experiment", over the period September 15, 1970 to February 3, 1971.



- COYOTE M
- COYOTE O
- COYOTE N
MEAN TIME (sec) AT POST
ODOR POST
CONTROL POST
WEEK
0
5
10
15
20
25
30
35
1
2
3
4
5
6
7
8
9
10
11
12
13
14
17
16

Fig. 37. Relationship between the test odor and the week of the experiment, in relation to the total time that coyotes M, O, and N spent at the odor post during the "M-O-N Experiment", over the period September 15, 1970 to February 3, 1971. The odors used were:

1. Urine - coyote M (G-JM1-3)
2. Feces - "
3. Urine - coyote O (G-JF2-3)
4. Feces - "
5. Urine - coyote N (G-JF3-3)
6. Feces - "
7. Urine - coyote P (N-JM1-3)
8. Feces - "
9. Urine - coyote Q (N-JF2-3)
10. Feces - "
11. Urine - coyote S (N-JF3-3)
12. Feces - "
13. No odor

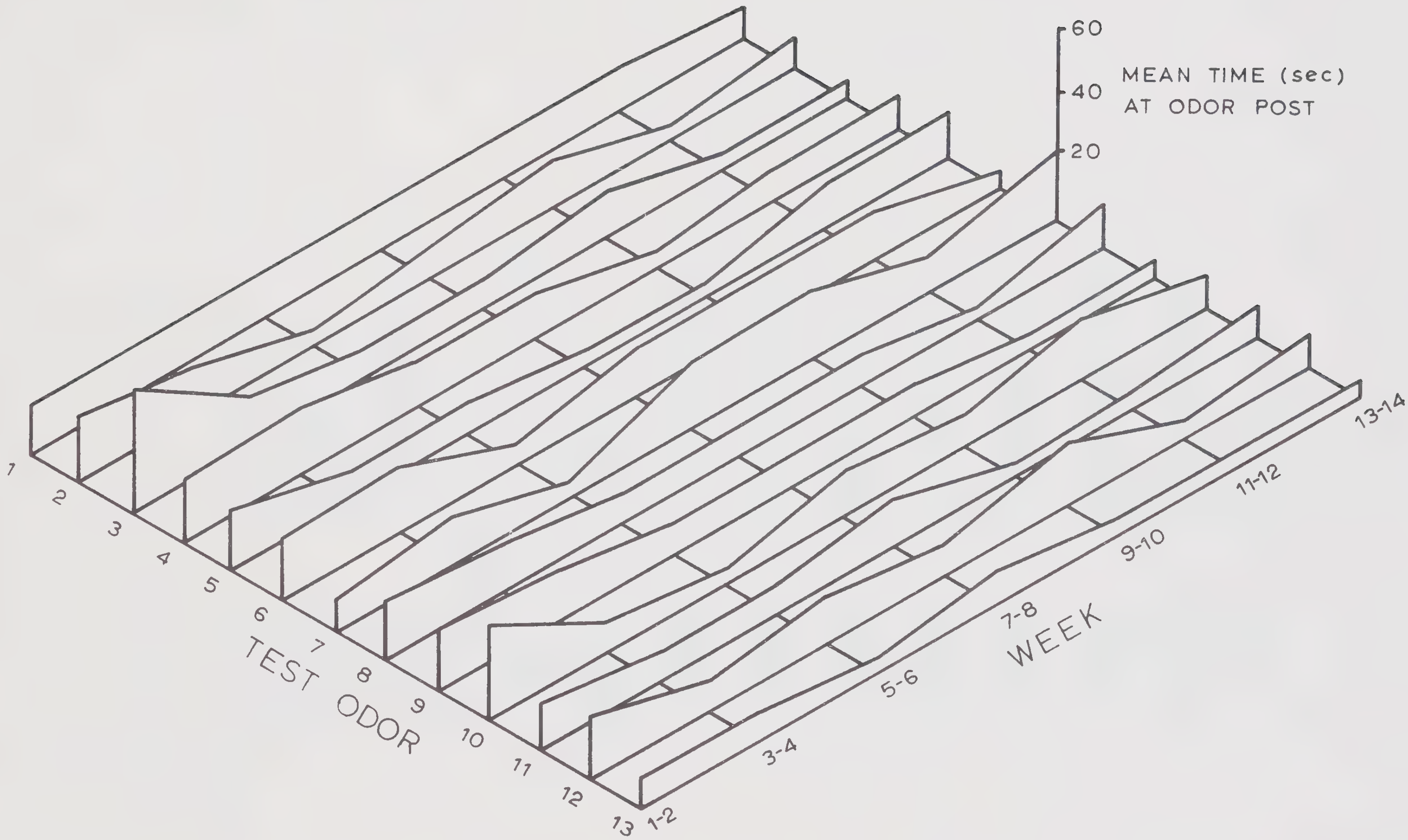
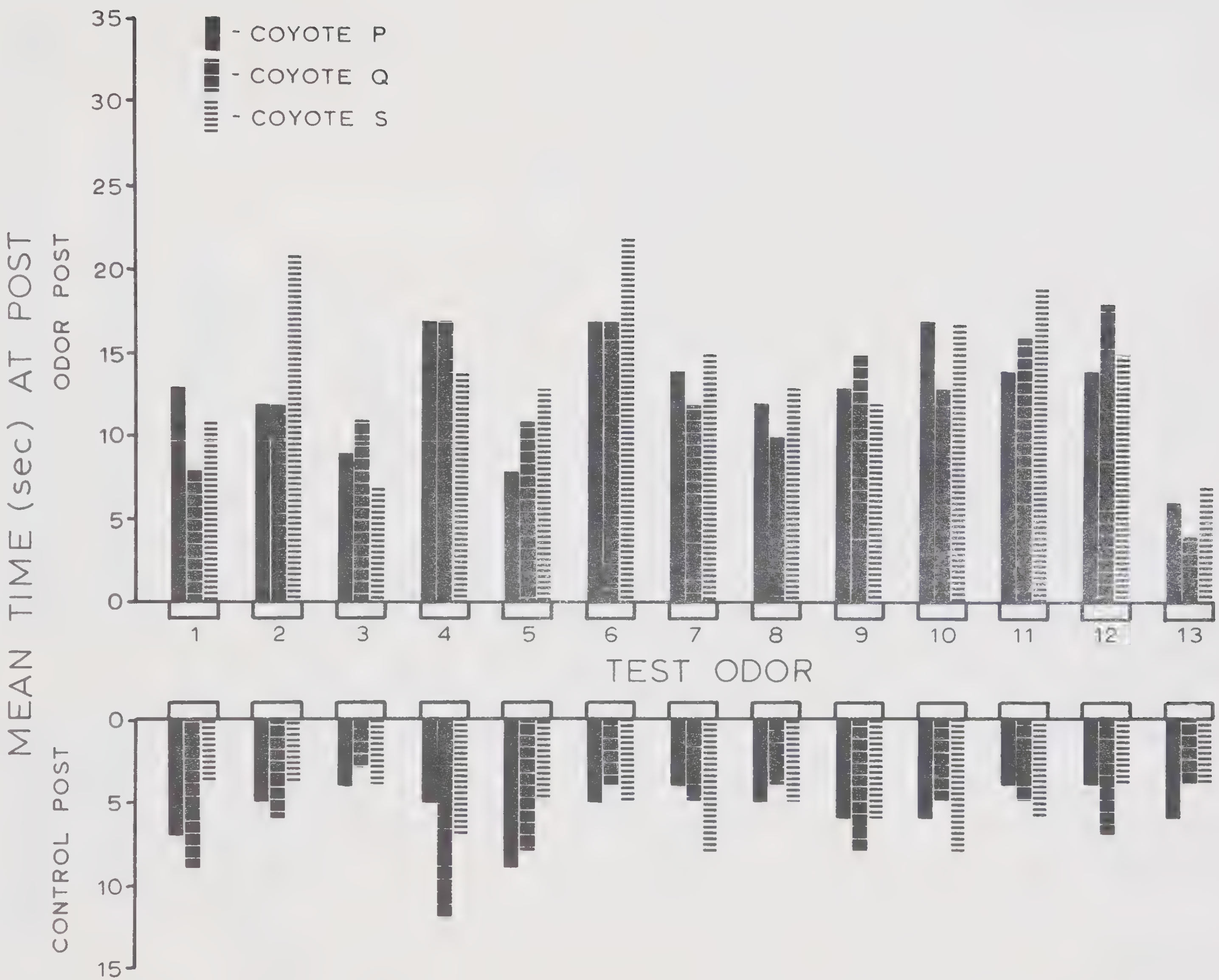

60
40
20
MEAN TIME (sec)
AT ODOR POST
1
2
3
4
5
6
7
8
9
10
11
12
13
TEST ODOR
1-2
3-4
5-6
7-8
9-10
11-12
13-14
WEEK

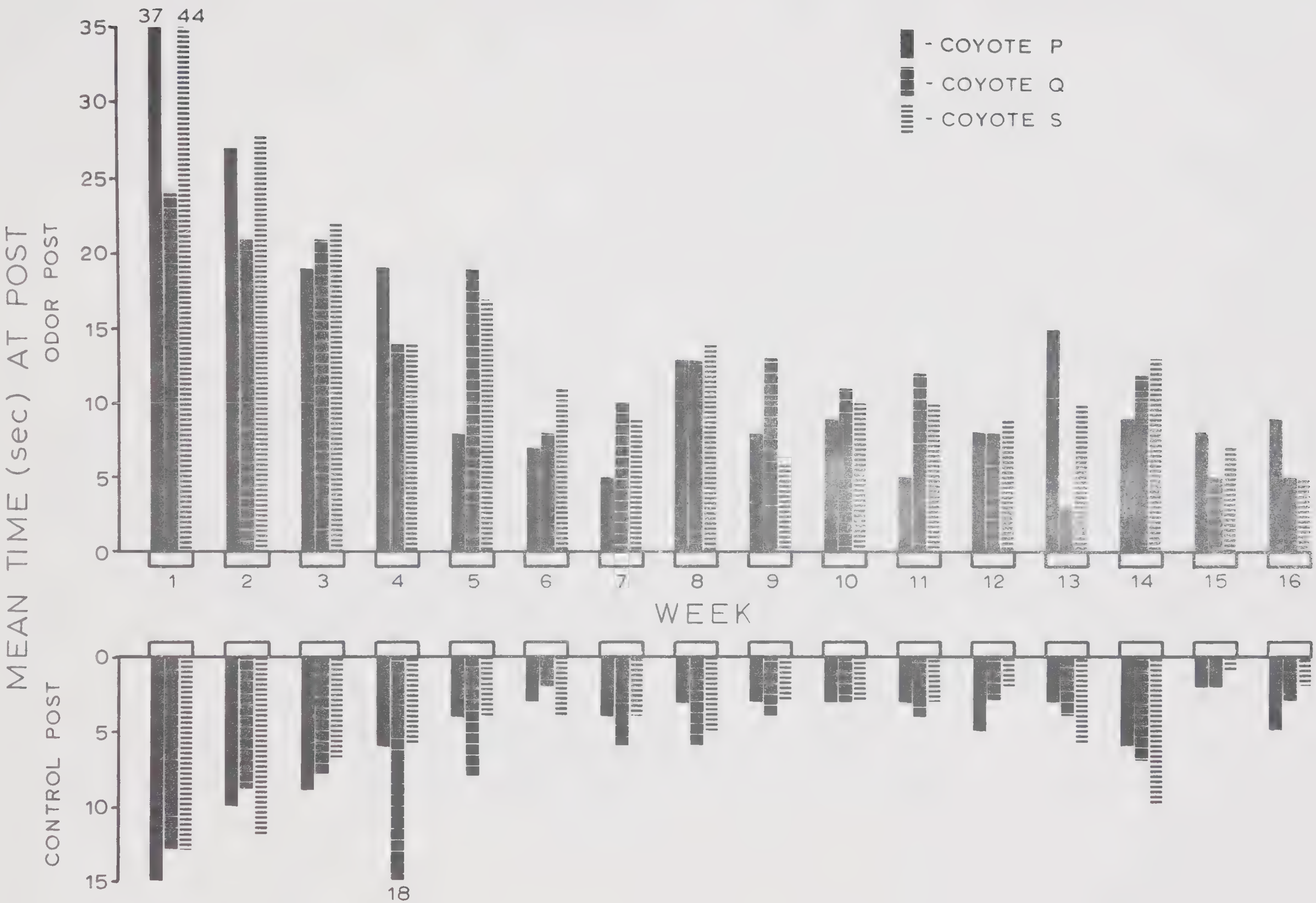
Fig. 38. Relationship between the test odor and the total time that coyotes P, Q, and S spent at the posts during the "P-Q-S Experiment", over the period September 16, 1970 to February 25, 1971. The odors used were:

1. Urine - coyote P (G-JM1-3)
2. Feces - "
3. Urine - coyote Q (G-JF2-3)
4. Feces - "
5. Urine - coyote S (G-JF3-3)
6. Feces - "
7. Urine - coyote M (N-JM1-3)
8. Feces - "
9. Urine - coyote O (N-JF2-3)
10. Feces - "
11. Urine - coyote N (N-JF3-3)
12. Feces - "
13. No odor



- COYOTE P
- COYOTE Q
- COYOTE S
MEAN TIME (sec) AT POST
ODOR POST
CONTROL POST
TEST ODOR
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
8
9
10
11
12
13

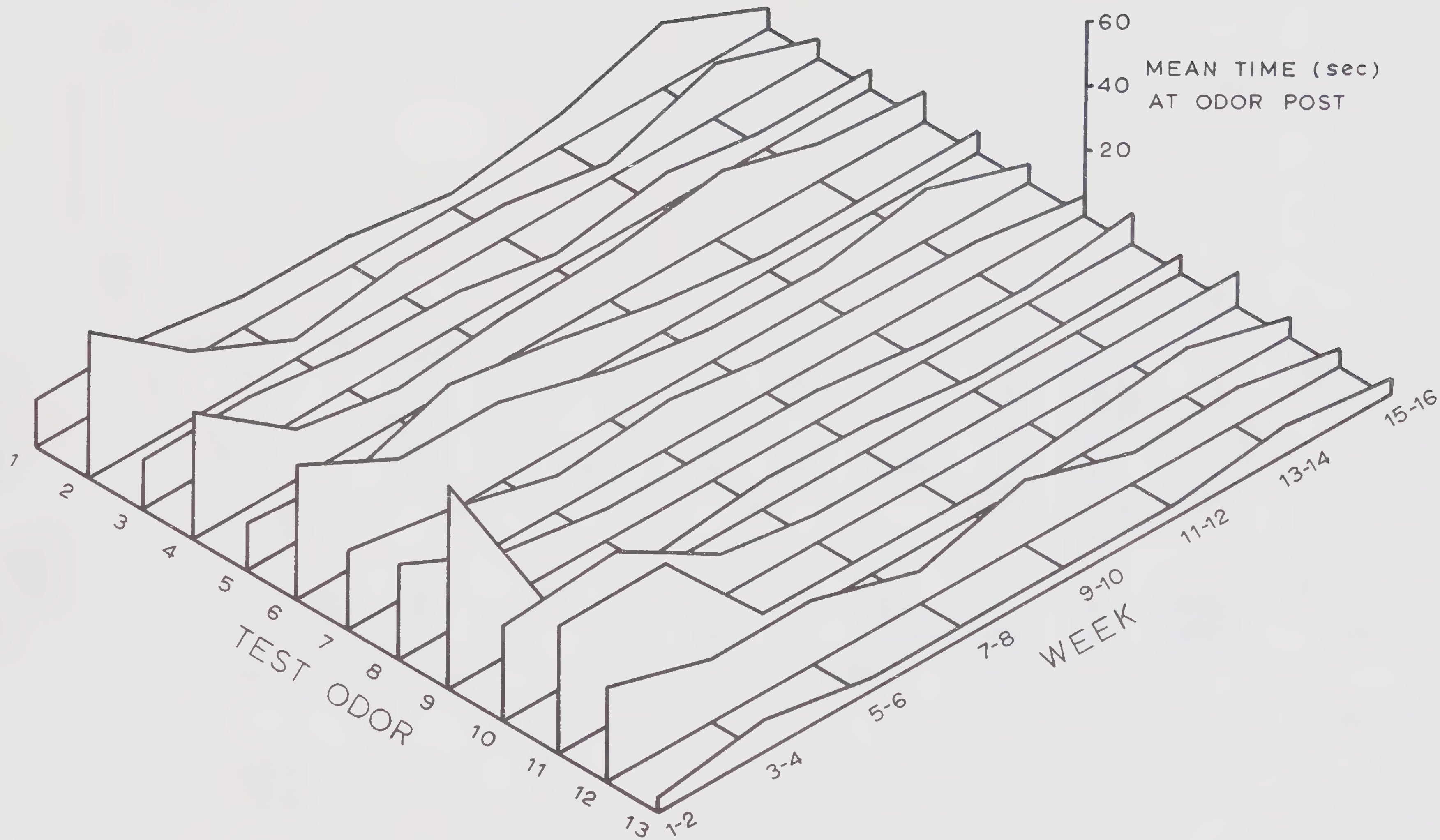
Fig. 39. Relationship between the week of the experiment and the total time that coyotes P, Q, and S spent at the posts during the "P-Q-S Experiment", over the period September 16, 1970 to February 25, 1971.



MEAN TIME (sec) AT POST
ODOR POST
CONTROL POST
WEEK
- COYOTE P
- COYOTE Q
- COYOTE S
37
44
18
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16

Fig. 40. Relationship between the test odor and the week of the experiment, in relation to the total time that coyotes P, Q, and S spent at the odor post during the "P-Q-S Experiment", over the period September 16, 1970 to February 25, 1971. The odors used were:

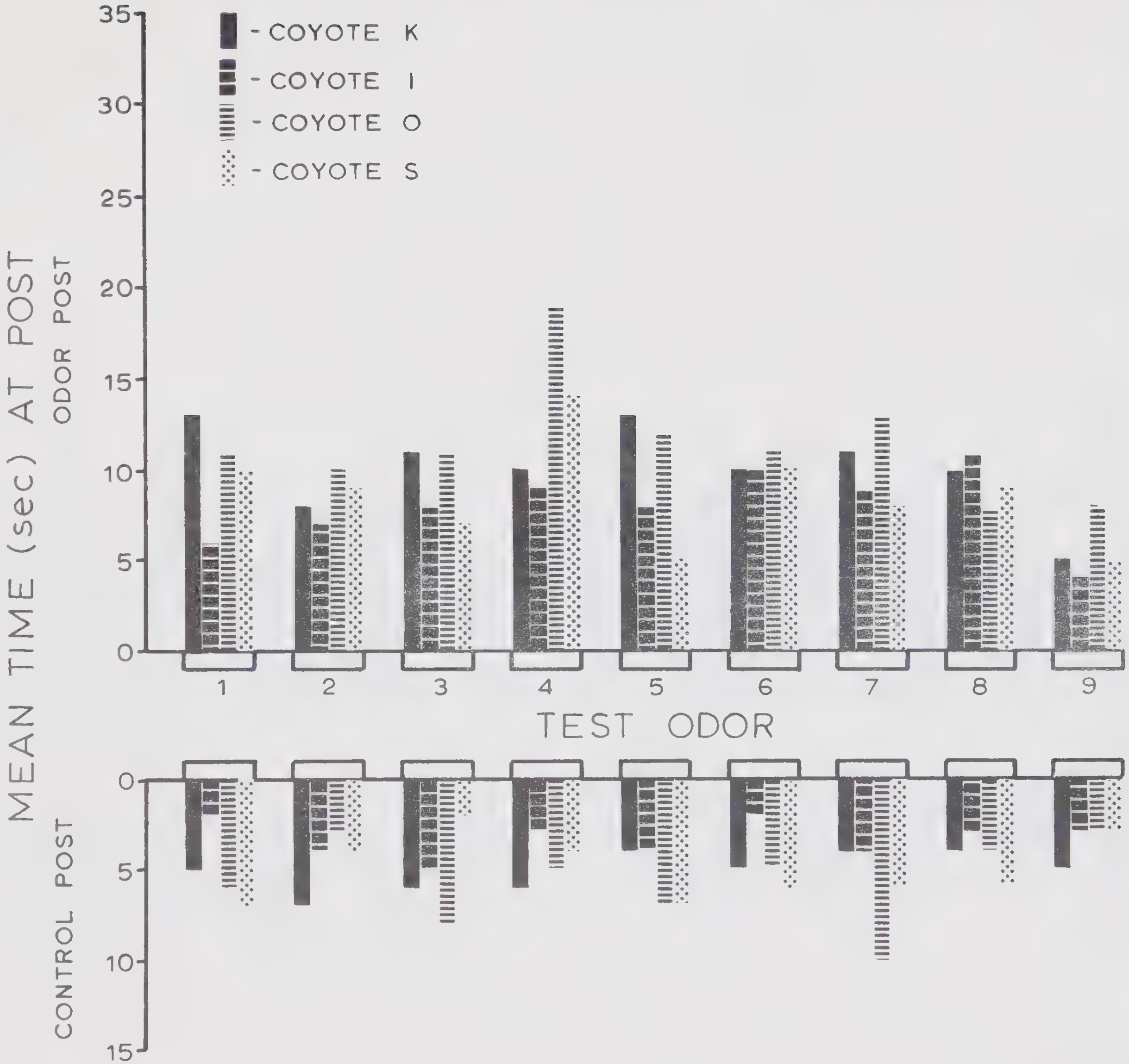
1. Urine - coyote P (G-JM1-3)
2. Feces - "
3. Urine - coyote Q (G-JF2-3)
4. Feces - "
5. Urine - coyote S (G-JF3-3)
6. Feces - "
7. Urine - coyote M (N-JM1-3)
8. Feces - "
9. Urine - coyote O (N-JF2-3)
10. Feces - "
11. Urine - coyote N (N-JF3-3)
12. Feces - "
13. No odor



60
40
20
MEAN TIME (sec)
AT ODOR POST
1
2
3
4
5
6
7
8
9
10
11
12
13
TEST ODOR
1-2
3-4
5-6
7-8
9-10
11-12
13-14
15-16
WEEK

Fig. 41. Relationship between the test odor and the total time that coyotes K, I, O, and S spent at the posts during the "K-I-O-S Experiment", over the period March 30 to July 22, 1971. The odors used were:

1. Urine - coyote M (N-JM1-4)
2. Feces - "
3. Urine - coyote P (N-JM2-4)
4. Feces - "
5. Urine - coyote Q (N-AF3-4)
6. Feces - "
7. Urine - coyote N (N-AF4-4)
8. Feces - "
9. No odor



MEAN TIME (sec) AT POST
ODOR POST
CONTROL POST
TEST ODOR
- COYOTE K
- COYOTE I
- COYOTE O
- COYOTE S

Fig. 42. Relationship between the week of the experiment and the total time that coyotes K, I, O, and S spent at the posts during the "K-I-O-S Experiment", over the period March 30 to July 22, 1971.

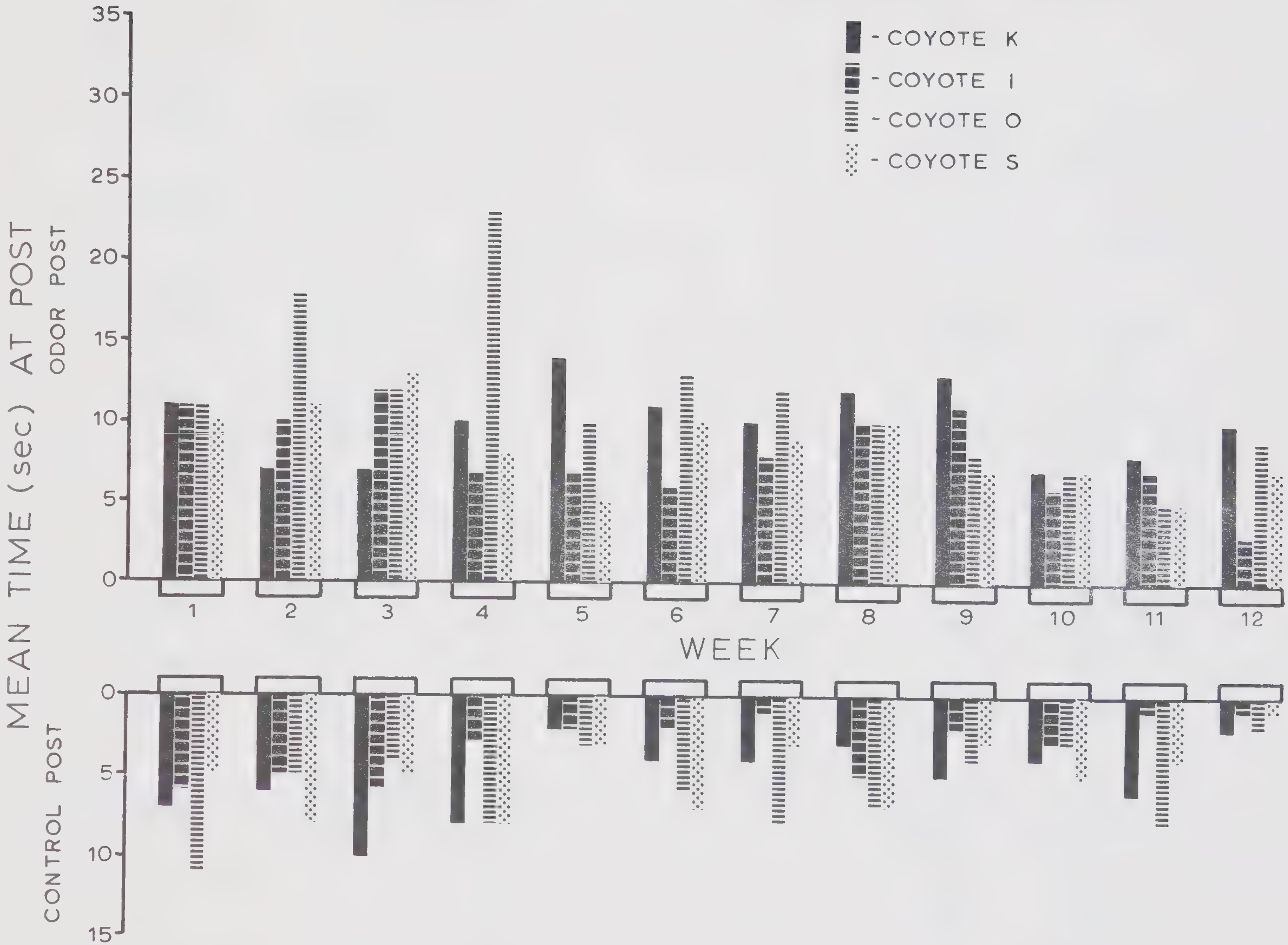
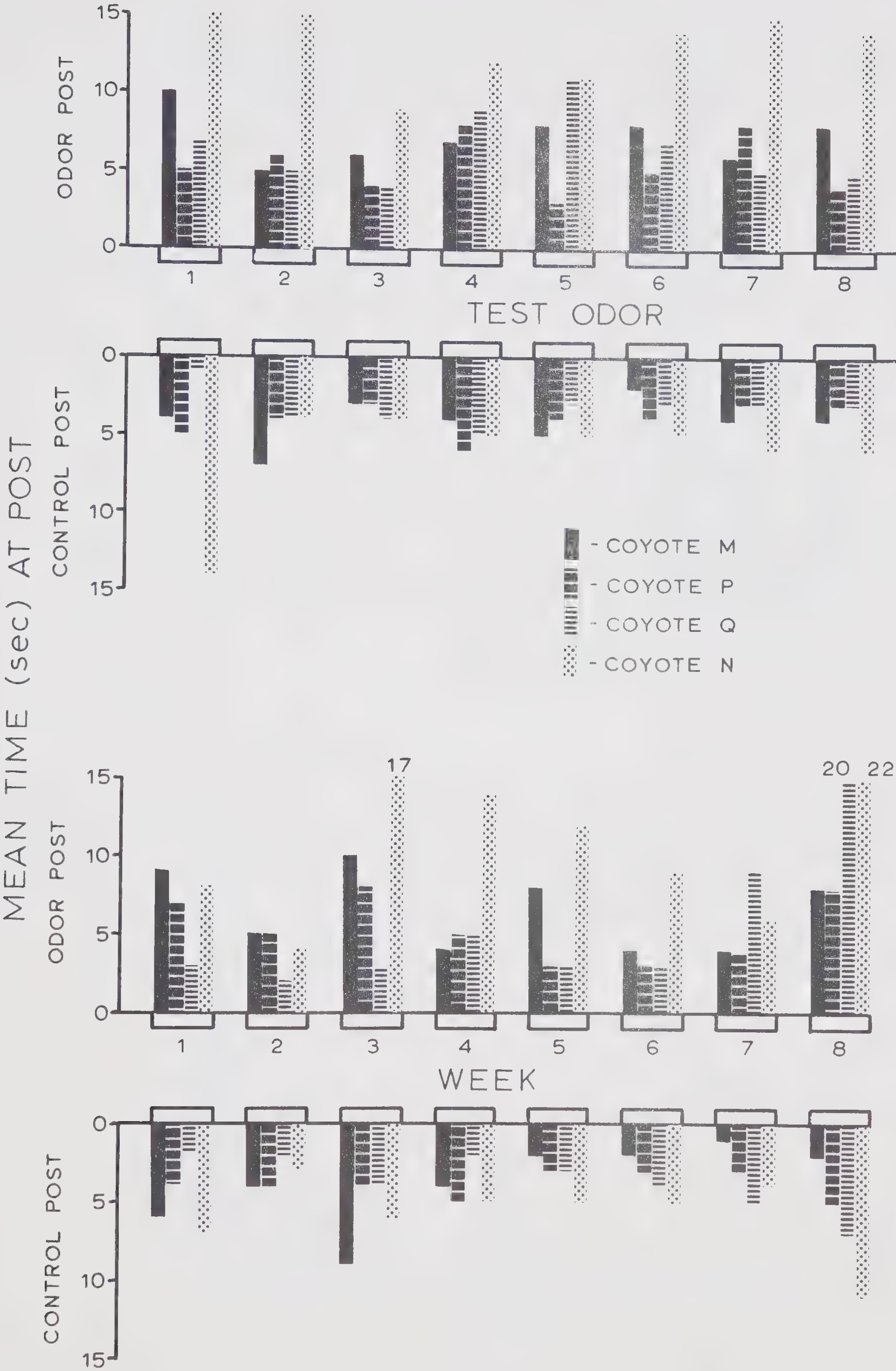

- COYOTE K
- COYOTE I
- COYOTE O
- COYOTE S
MEAN TIME (sec) AT POST
ODOR POST
CONTROL POST
WEEK
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
8
9
10
11
12

Fig. 43. Relationship between the test odor and the total time that coyotes M, P, Q, and N spent at the posts during the "M-P-Q-N Experiment", over the period March 31 to June 11, 1971.

The odors used were:

1. Urine - coyote K (N-AM1-4)
2. Feces - "
3. Urine - coyote I (N-AM2-4)
4. Feces - "
5. Urine - coyote O (N-AF3-4)
6. Feces - "
7. Urine - coyote S (N-AF4-4)
8. Feces - "
9. No odor

Fig. 44. Relationship between the week of the experiment and the total time that coyotes M, P, Q, and N spent at the posts during the "M-P-Q-N Experiment", over the period March 31 to June 11, 1971.

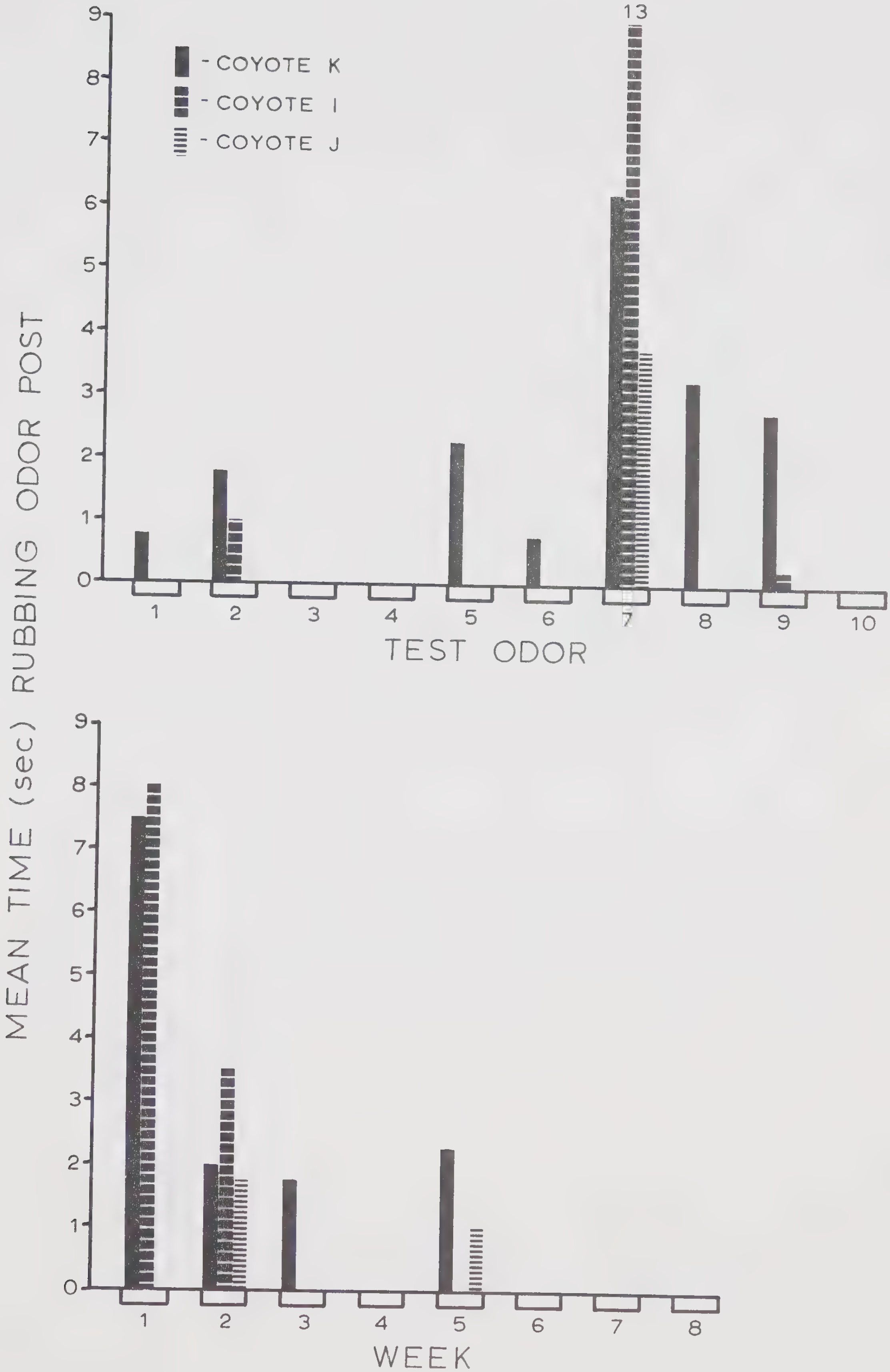


MEAN TIME (sec) AT POST
ODOR POST
CONTROL POST
TEST ODOR
1
2
3
4
5
6
7
8
9
0
5
10
15
- COYOTE M
- COYOTE P
- COYOTE Q
- COYOTE N
WEEK
17
20
22

Fig. 45. Relationship between the test odor and the time that coyotes K, I, and J spent rubbing the odor post during the "Urine Experiment", over the period June 22 to August 20, 1970. The odors used were urine from:

1. Coyote K (G-AM1-3)
2. Coyote I (G-AM2-3)
3. Coyote J (G-AM3-3)
4. Coyote M (N-PM1-3)
5. Coyote O (N-PF2-3)
6. Coyote N (N-PF3-3)
7. Male domestic dog
8. Female domestic dog (anestrus)
9. Female domestic dog (estrus)
10. No odor

Fig. 46. Relationship between the week of the experiment and the time that coyotes K, I, and J spent rubbing the odor post during the "Urine Experiment", over the period June 22 to August 20, 1970.

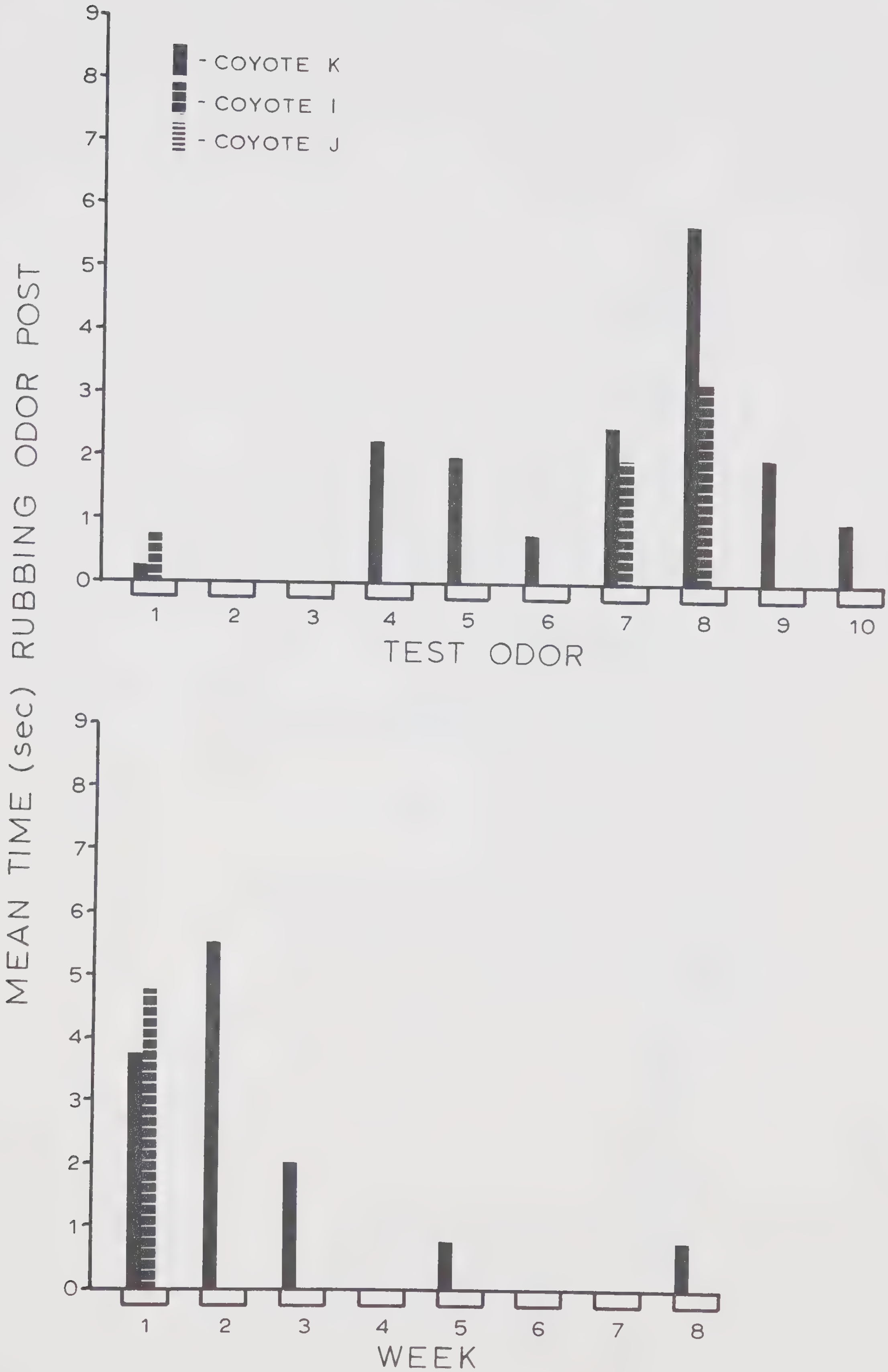


MEAN TIME (sec) RUBBING ODOR POST
13
- COYOTE K
- COYOTE I
- COYOTE J
0
1
2
3
4
5
6
7
8
9
10
TEST ODOR
WEEK

Fig. 47. Relationship between the test odor and the time that coyotes K, I, and J spent rubbing the odor post during the "Feces Experiment", over the period June 23 to August 19, 1970. The odors used were feces from:

1. Coyote K (G-AM1-3)
2. Coyote I (G-AM2-3)
3. Coyote J (G-AM3-3)
4. Coyote M (N-PM1-3)
5. Coyote O (N-PF2-3)
6. Coyote N (N-PF3-3)
7. Male domestic dog
8. Female domestic dog (anestrus)
9. Female domestic dog (estrus)
10. No odor

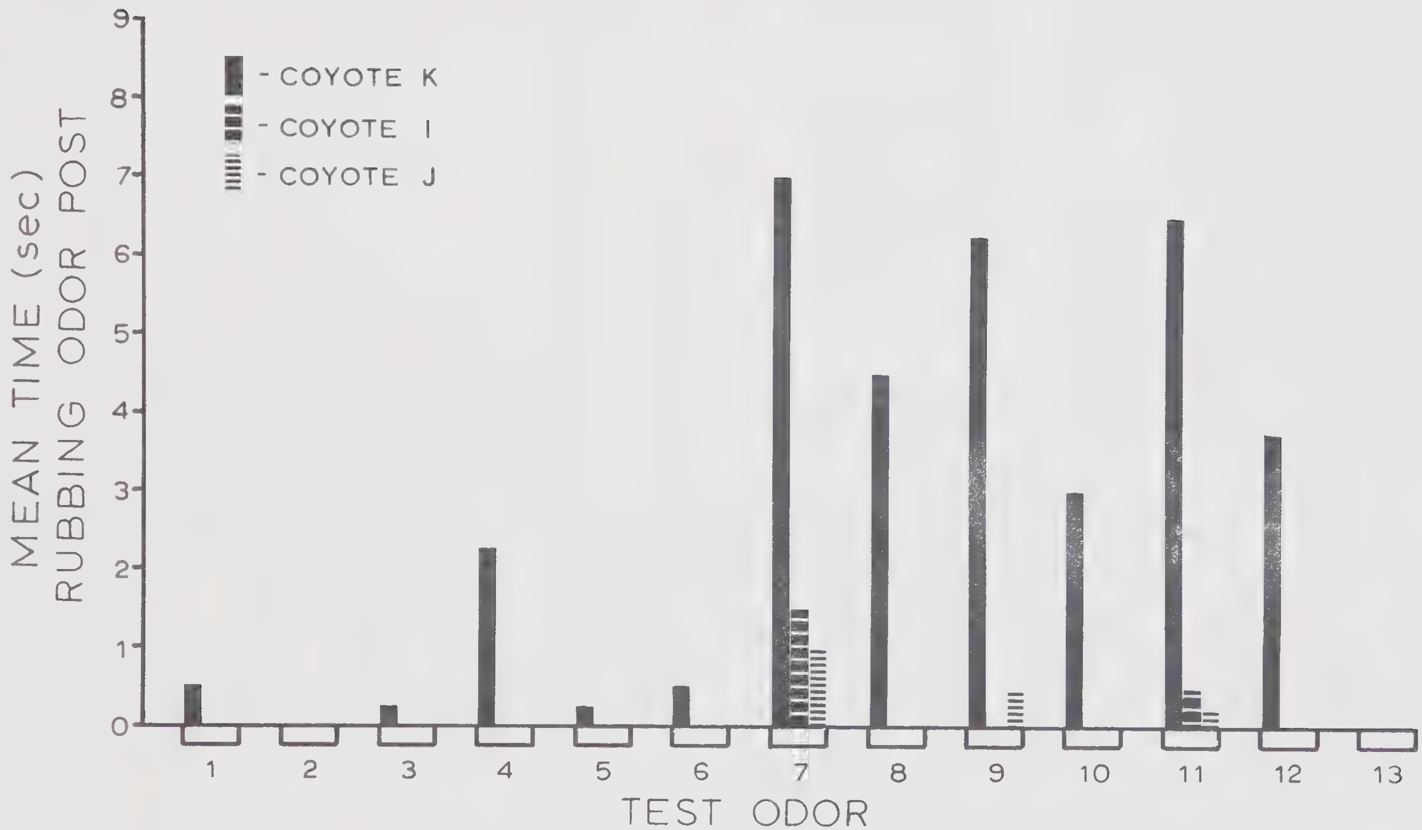
Fig. 48. Relationship between the week of the experiment and the time that coyotes K, I, and J spent rubbing the odor post during the "Feces Experiment", over the period June 23 to August 19, 1970.



- COYOTE K
- COYOTE I
- COYOTE J
MEAN TIME (sec) RUBBING ODOR POST
TEST ODOR
WEEK

Fig. 49. Relationship between the test odor and the time that coyotes K, I, and J spent rubbing the odor post during the "K-I-J Experiment", over the period September 14, 1970 to February 23, 1971. The odors used were:

1. Urine - coyote K (G-AM1-3)
2. Feces - "
3. Urine - coyote I (G-AM2-3)
4. Feces - "
5. Urine - coyote J (G-AM3-3)
6. Feces - "
7. Urine - male domestic dog
8. Feces - "
9. Urine - female domestic dog (anestrus)
10. Feces - "
11. Urine - female domestic dog (estrus)
12. Feces - "
13. No odor



MEAN TIME (sec) RUBBING ODOR POST
- COYOTE K
- COYOTE I
- COYOTE J
0
1
2
3
4
5
6
7
8
9
1
2
3
4
5
6
7
8
9
10
11
12
13
TEST ODOR

Fig. 50. Relationship between the week of the experiment and the time that coyotes K, I, and J spent rubbing the odor post during the "K-I-J Experiment", over the period September 14, 1970 to February 23, 1971.

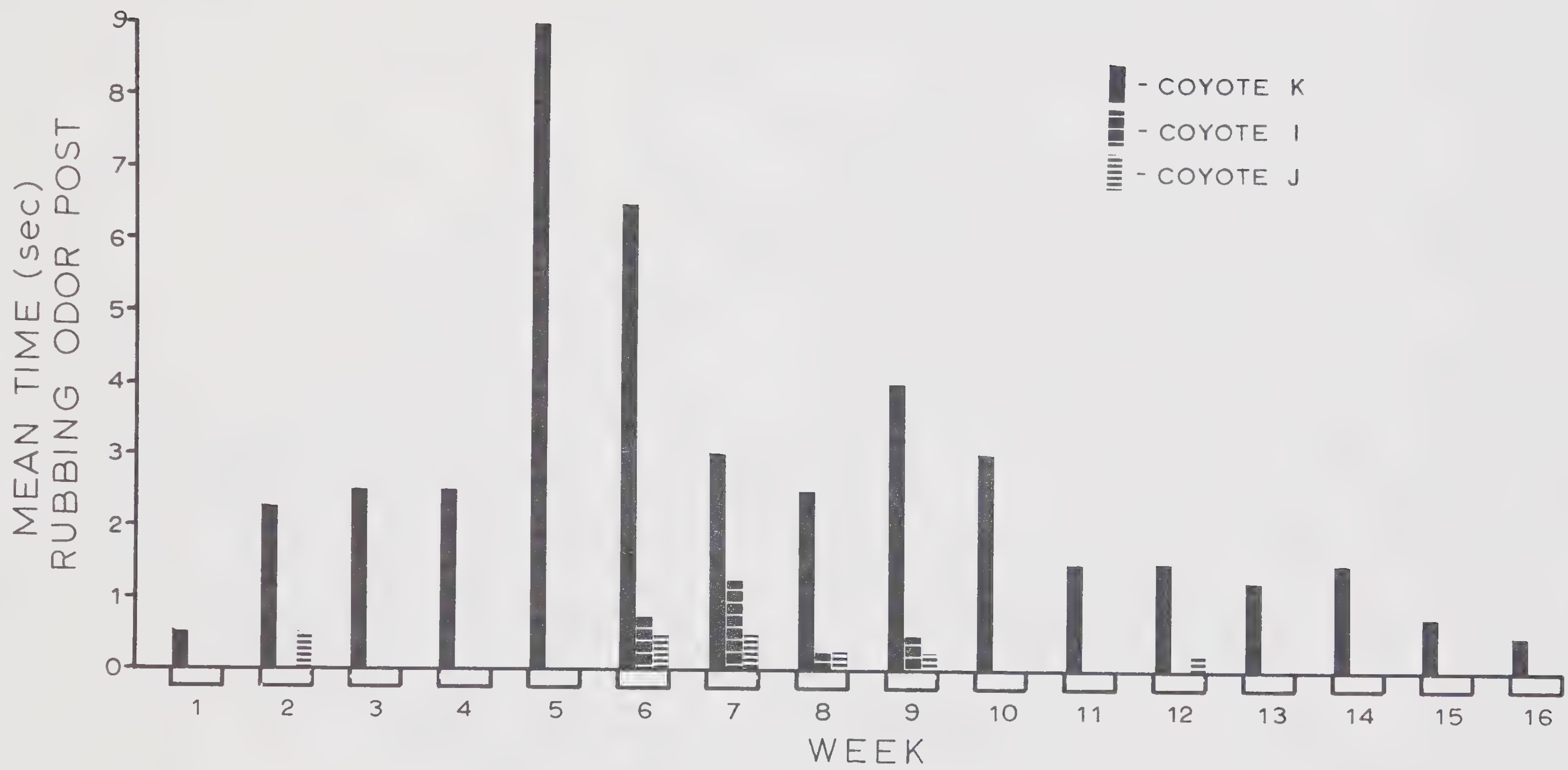

MEAN TIME (sec)
RUBBING ODOR POST
0
1
2
3
4
5
6
7
8
9
WEEK
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
- COYOTE K
- COYOTE I
- COYOTE J

Fig. 51. Relationship between the test odor and the week of the experiment, in relation to the time that coyotes K, I, and J rubbed the odor post during the "K-I-J Experiment", over the period September 14, 1970 to February 23, 1971. The odors used were:

1. Urine - coyote K (G-AM1-3)
2. Feces - "
3. Urine - coyote I (G-AM2-3)
4. Feces - "
5. Urine - coyote J (G-AM3-3)
6. Feces - "
7. Urine - male domestic dog
8. Feces - "
9. Urine - female domestic dog (anestrus)
10. Feces - "
11. Urine - female domestic dog (estrus)
12. Feces - "
13. No odor

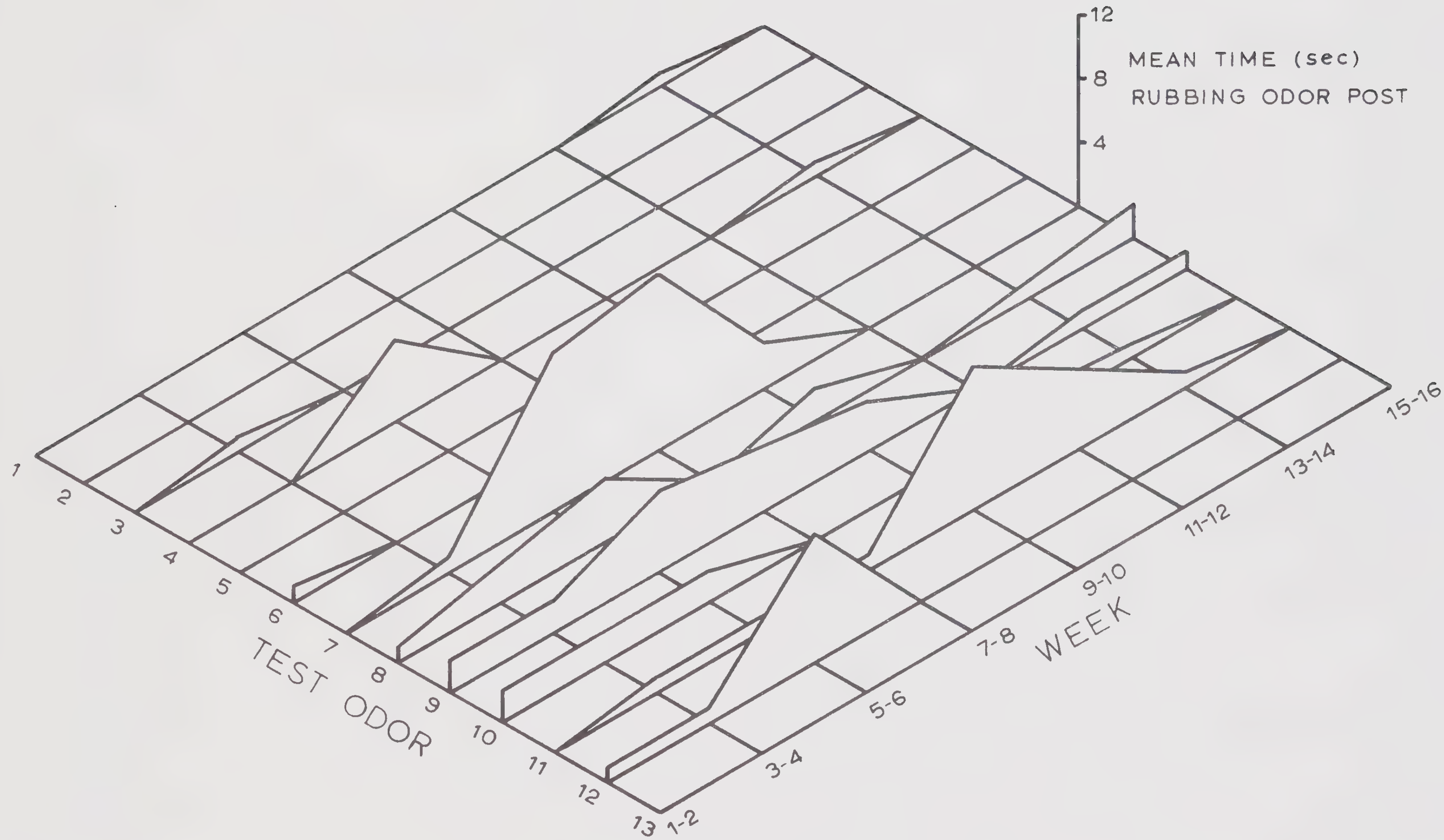
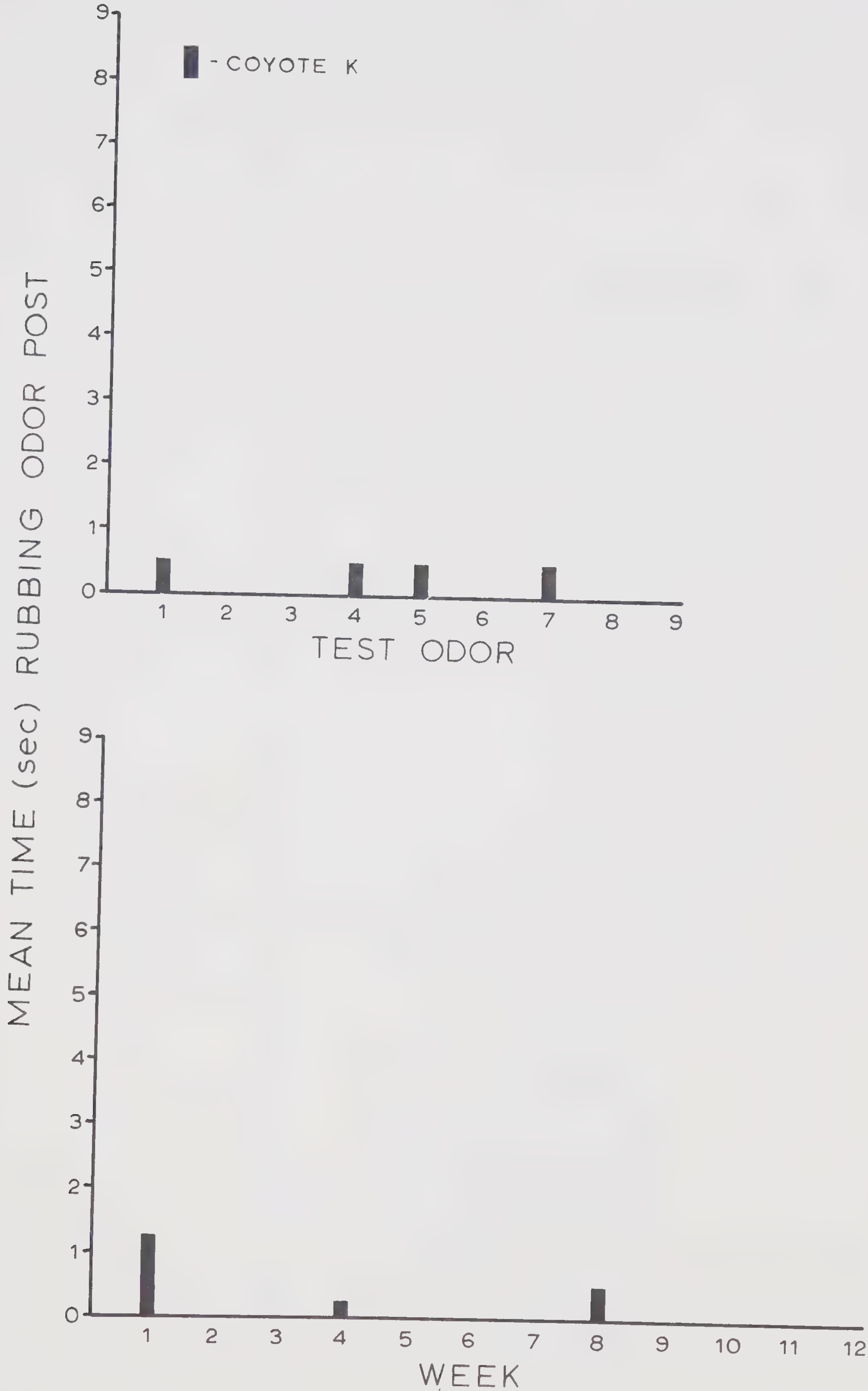

MEAN TIME (sec)
RUBBING ODOR POST
12
8
4
TEST ODOR
1
2
3
4
5
6
7
8
9
10
11
12
13
WEEK
1-2
3-4
5-6
7-8
9-10
11-12
13-14
15-16

Fig. 52. Relationship between the test odor and the time that coyote K rubbed the odor post during the "K-I-O-S Experiment", over the period March 30 to July 22, 1971. The odors used were:

1. Urine - coyote M (N-JM1-4)
2. Feces - "
3. Urine - coyote P (N-JM2-4)
4. Feces - "
5. Urine - coyote Q (N-AF3-4)
6. Feces - "
7. Urine - coyote N (N-AF4-4)
8. Feces - "
9. No odor

Fig. 53. Relationship between the week of the experiment and the time that coyote K rubbed the odor post during the "K-I-O-S Experiment", over the period March 30 to July 22, 1971.

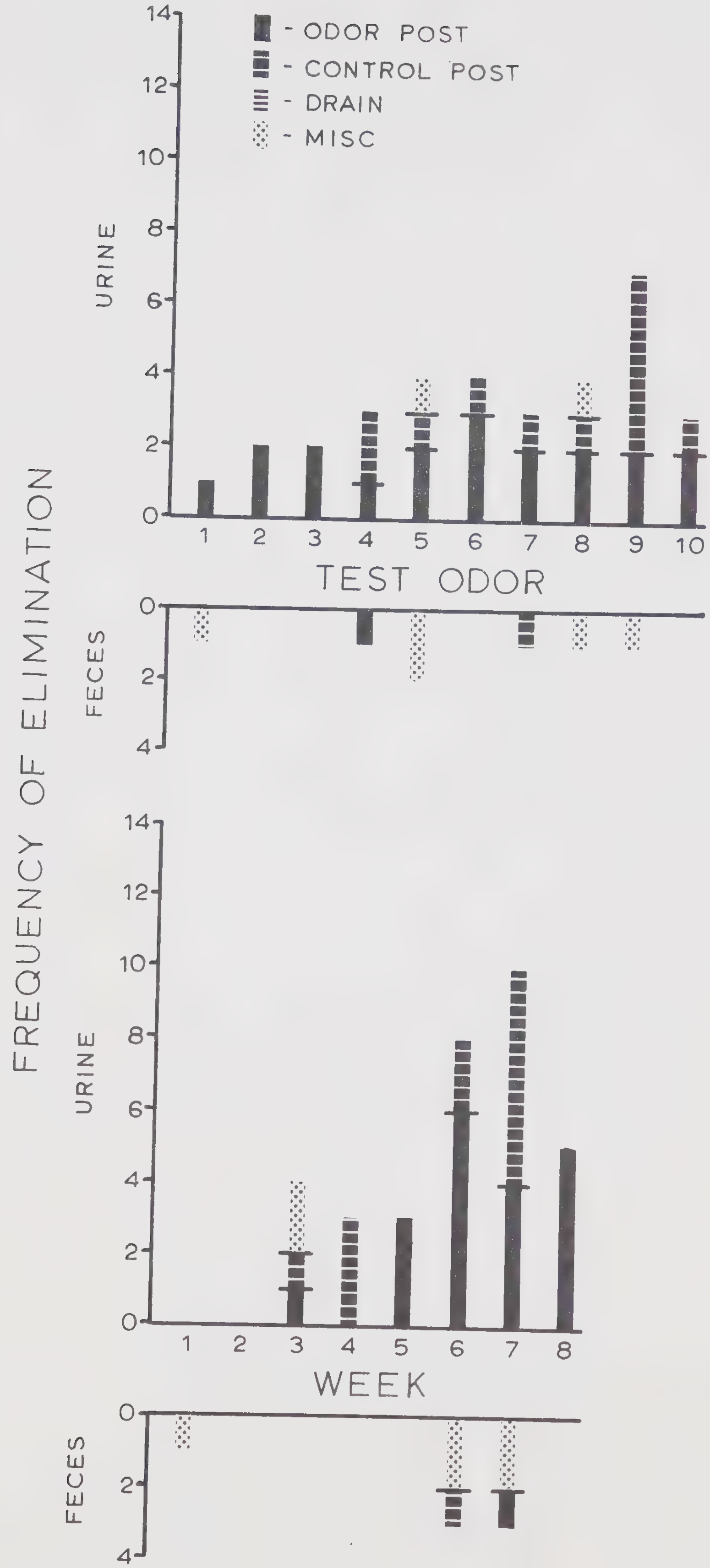


- COYOTE K
MEAN TIME (sec) RUBBING ODOR POST
TEST ODOR
WEEK

Fig. 54. Relationship between the test odor and elimination by coyote K during the "Urine Experiment" over the period June 22 to August 20, 1970. The odors used were urine from:

1. Coyote K (G-AM1-3)
2. Coyote I (G-AM2-3)
3. Coyote J (G-AM3-3)
4. Coyote M (N-PM1-3)
5. Coyote O (N-PF2-3)
6. Coyote N (N-PF3-3)
7. Male domestic dog
8. Female domestic dog (anestrus)
9. Female domestic dog (estrus)
10. No odor

Fig. 55. Relationship between the week of the experiment and elimination by coyote K during the "Urine Experiment", over the period June 22 to August 20, 1970.

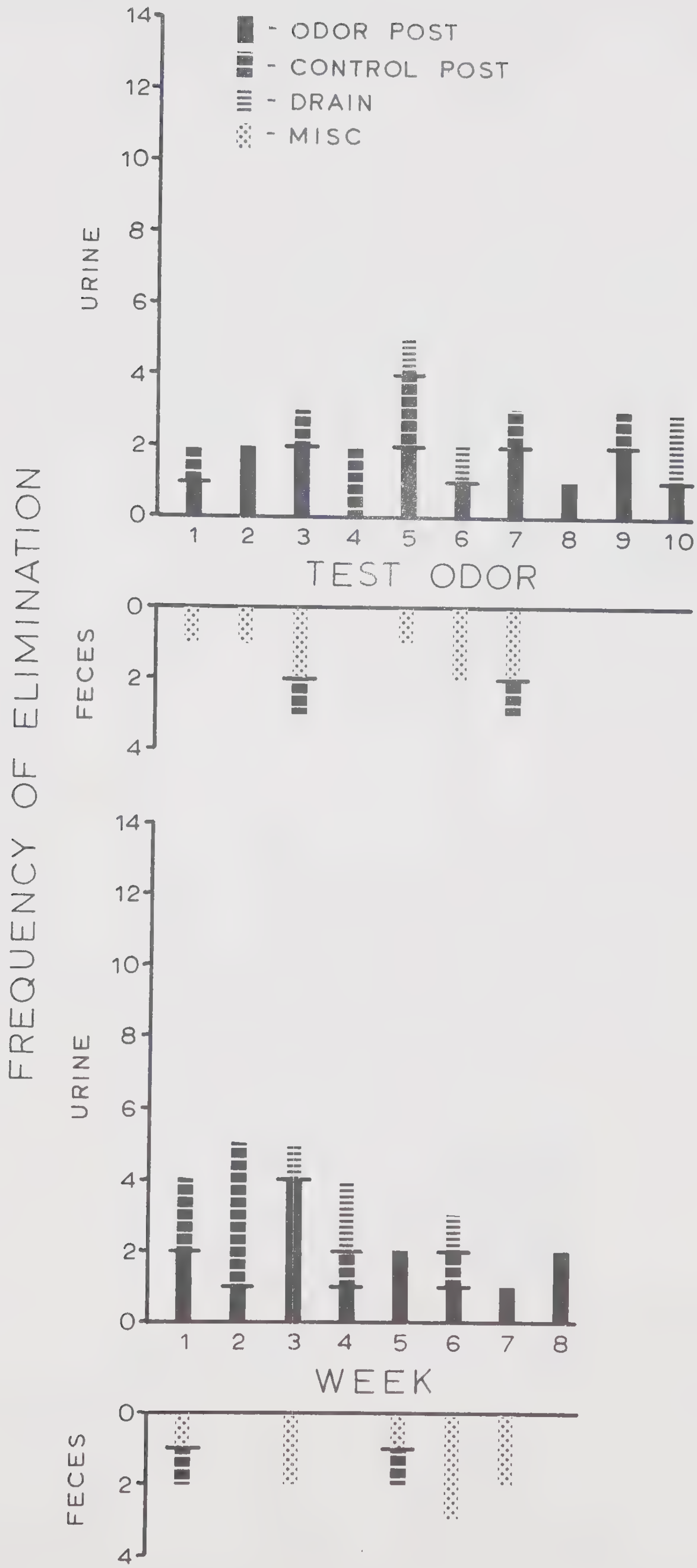


- ODOR POST
- CONTROL POST
- DRAIN
- MISC
FREQUENCY OF ELIMINATION
URINE
FECES
TEST ODOR
WEEK
0
2
4
6
8
10
12
14
1
2
3
4
5
6
7
8
9
10

Fig. 56. Relationship between the test odor and elimination by coyote I during the "Urine Experiment", over the period June 22 to August 20, 1970. The odors used were urine from:

1. Coyote K (G-AM1-3)
2. Coyote I (G-AM2-3)
3. Coyote J (G-AM3-3)
4. Coyote M (N-PM1-3)
5. Coyote O (N-PF2-3)
6. Coyote N (N-PF3-3)
7. Male domestic dog
8. Female domestic dog (anestrus)
9. Female domestic dog (estrus)
10. No odor

Fig. 57. Relationship between the week of the experiment and elimination by coyote I during the "Urine Experiment", over the period June 22 to August 20, 1970.



FREQUENCY OF ELIMINATION
ODOR POST
CONTROL POST
DRAIN
MISC
URINE
FECES
TEST ODOR
WEEK

Fig. 58. Relationship between the test odor and elimination by coyote J during the "Urine Experiment", over the period June 22 to August 20, 1970. The odors used were urine from:

1. Coyote K (G-AM1-3)
2. Coyote I (G-AM2-3)
3. Coyote J (G-AM3-3)
4. Coyote M (N-PM1-3)
5. Coyote O (N-PF2-3)
6. Coyote N (N-PF3-3)
7. Male domestic dog
8. Female domestic dog (anestrus)
9. Female domestic dog (estrus)
10. No odor

Fig. 59. Relationship between the week of the experiment and elimination by coyote J during the "Urine Experiment", over the period June 22 to August 20, 1970.

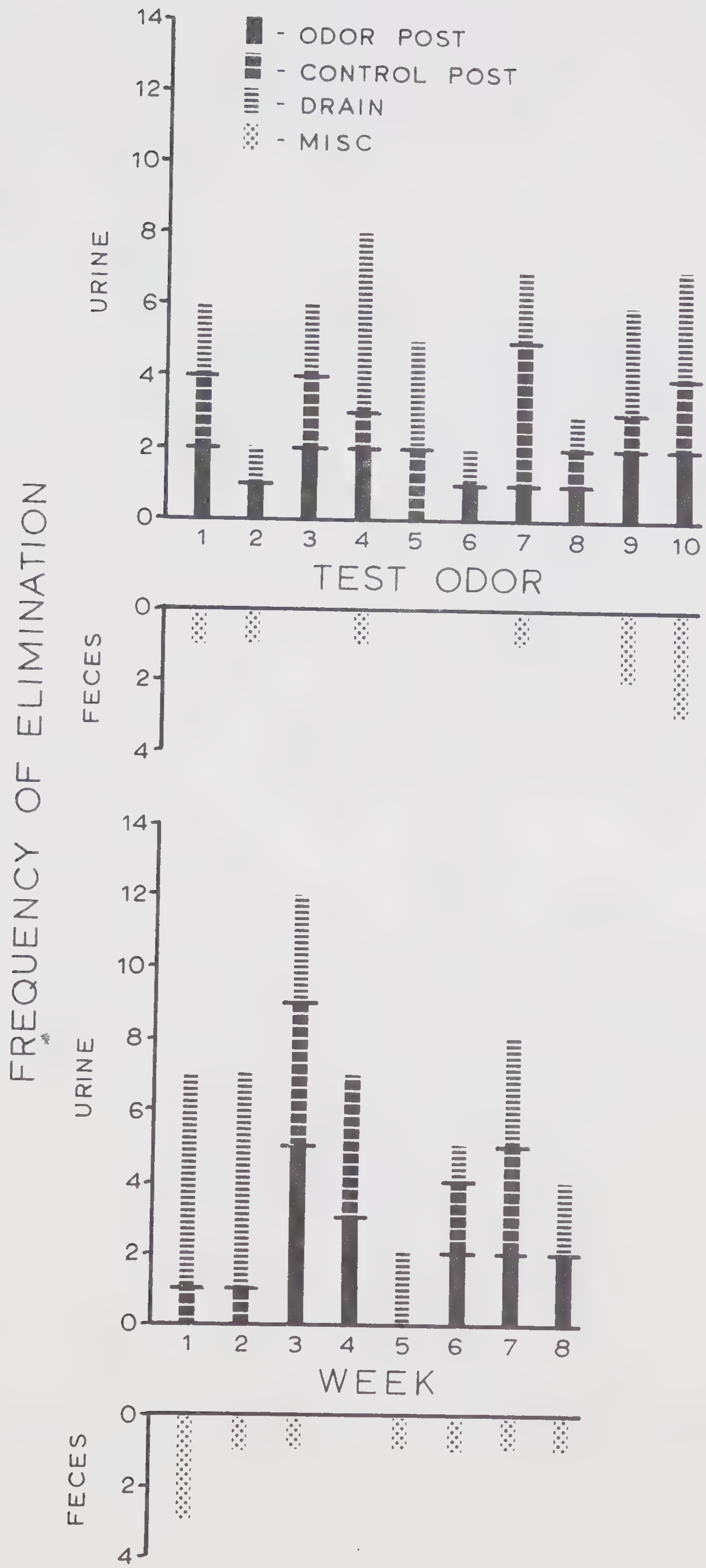
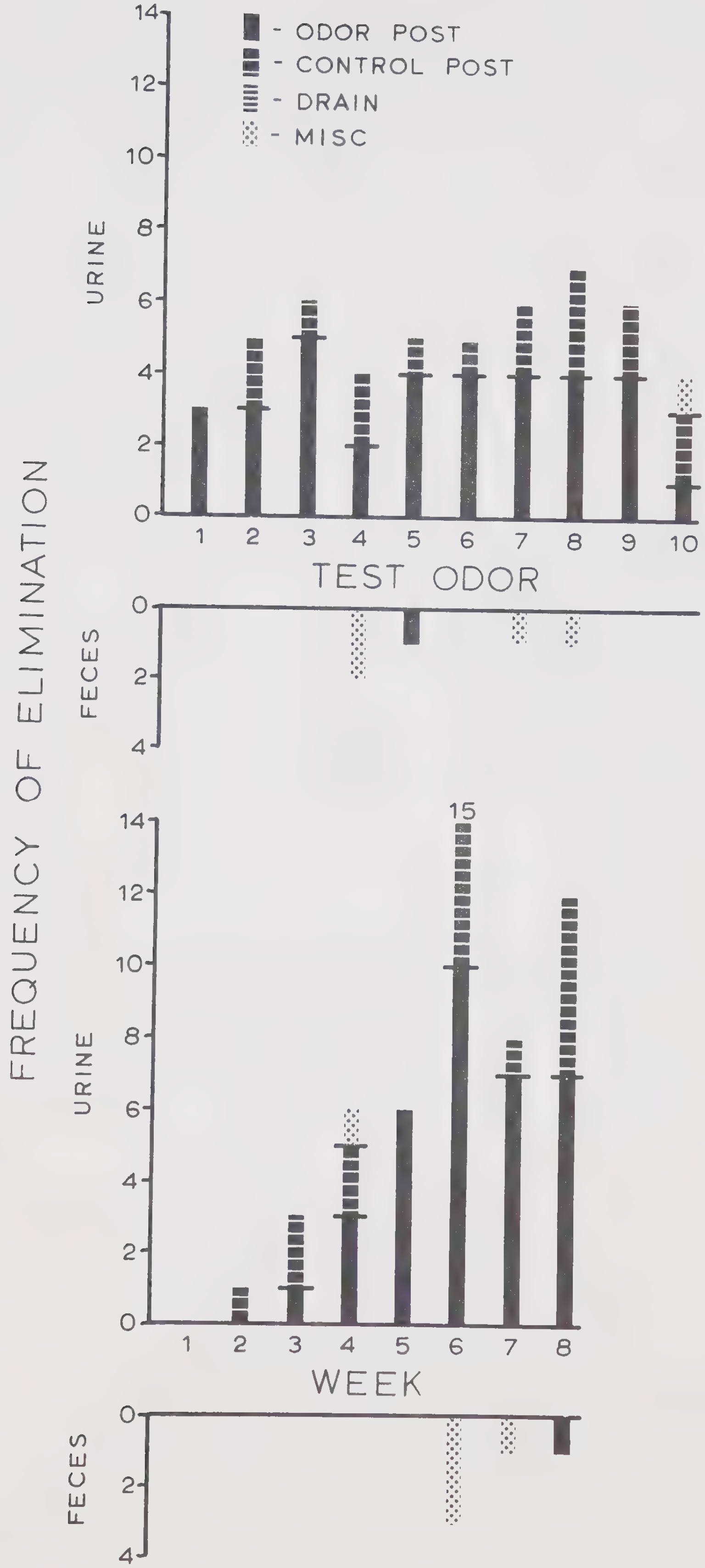

FREQUENCY OF ELIMINATION
ODOR POST
CONTROL POST
DRAIN
MISC
URINE
FECES
TEST ODOR
1 2 3 4 5 6 7 8 9 10
0 2 4 6 8 10 12 14
0 2 4
URINE
FECES
WEEK
1 2 3 4 5 6 7 8
0 2 4 6 8 10 12 14
0 2 4

Fig. 60. Relationship between the test odor and elimination by coyote K during the "Feces Experiment", over the period June 23 to August 19, 1970. The odors used were feces from:

1. Coyote K (G-AM1-3)
2. Coyote I (G-AM2-3)
3. Coyote J (G-AM3-3)
4. Coyote M (N-PM1-3)
5. Coyote O (N-PF2-3)
6. Coyote N (N-PF3-3)
7. Male domestic dog
8. Female domestic dog (anestrus)
9. Female domestic dog (estrus)
10. No odor

Fig. 61. Relationship between the week of the experiment and elimination by coyote K during the "Feces Experiment", over the period June 23 to August 19, 1970.

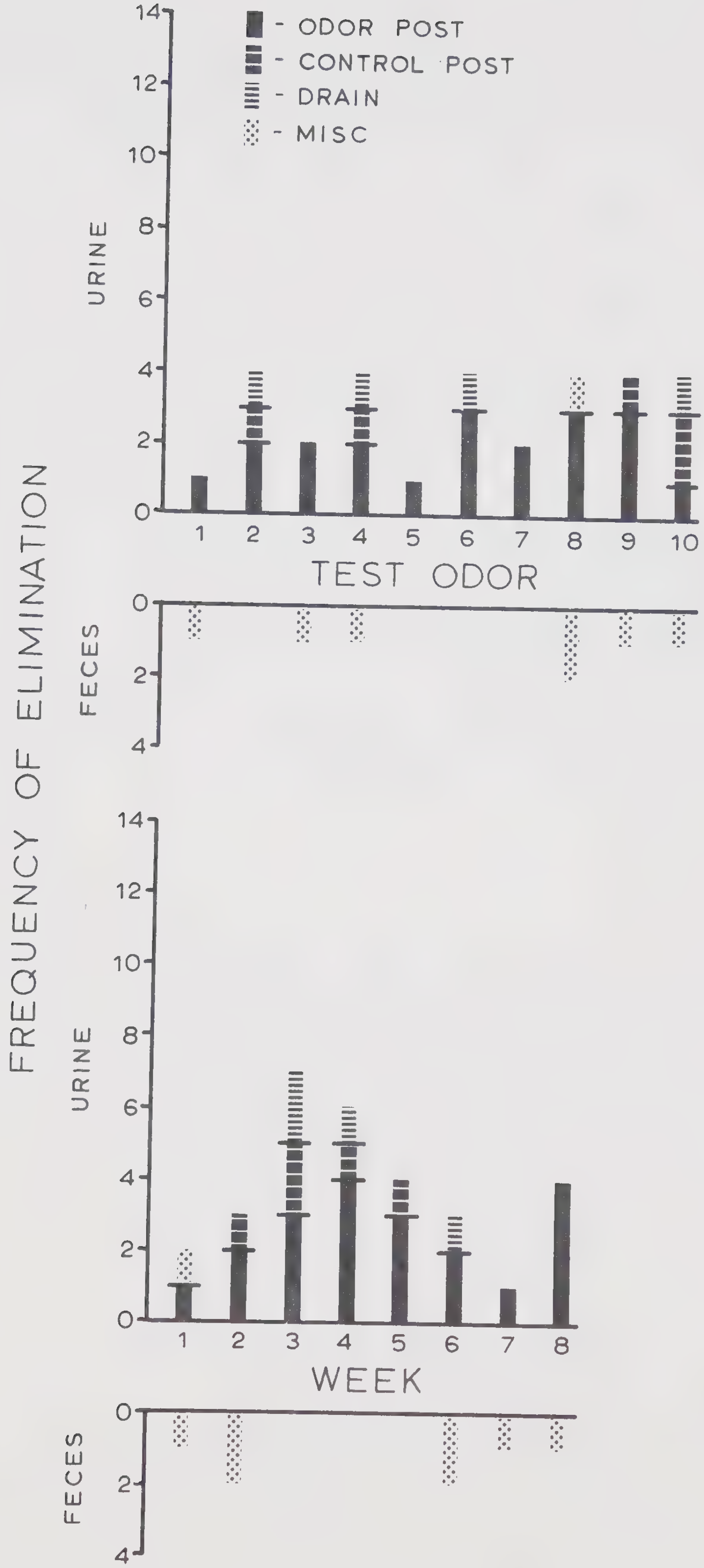


ODOR POST
CONTROL POST
DRAIN
MISC
URINE
FECES
TEST ODOR
WEEK
FREQUENCY OF ELIMINATION
15

Fig. 62. Relationship between the test odor and elimination by coyote I during the "Feces Experiment", over the period June 23 to August 19, 1970. The odors used were feces from:

1. Coyote K (G-AM1-3)
2. Coyote I (G-AM2-3)
3. Coyote J (G-AM3-3)
4. Coyote M (N-PM1-3)
5. Coyote O (N-PF2-3)
6. Coyote N (N-PF3-3)
7. Male domestic dog
8. Female domestic dog (anestrus)
9. Female domestic dog (estrus)
10. No odor

Fig. 63. Relationship between the week of the experiment and elimination by coyote I during the "Feces Experiment", over the period June 23 to August 19, 1970.

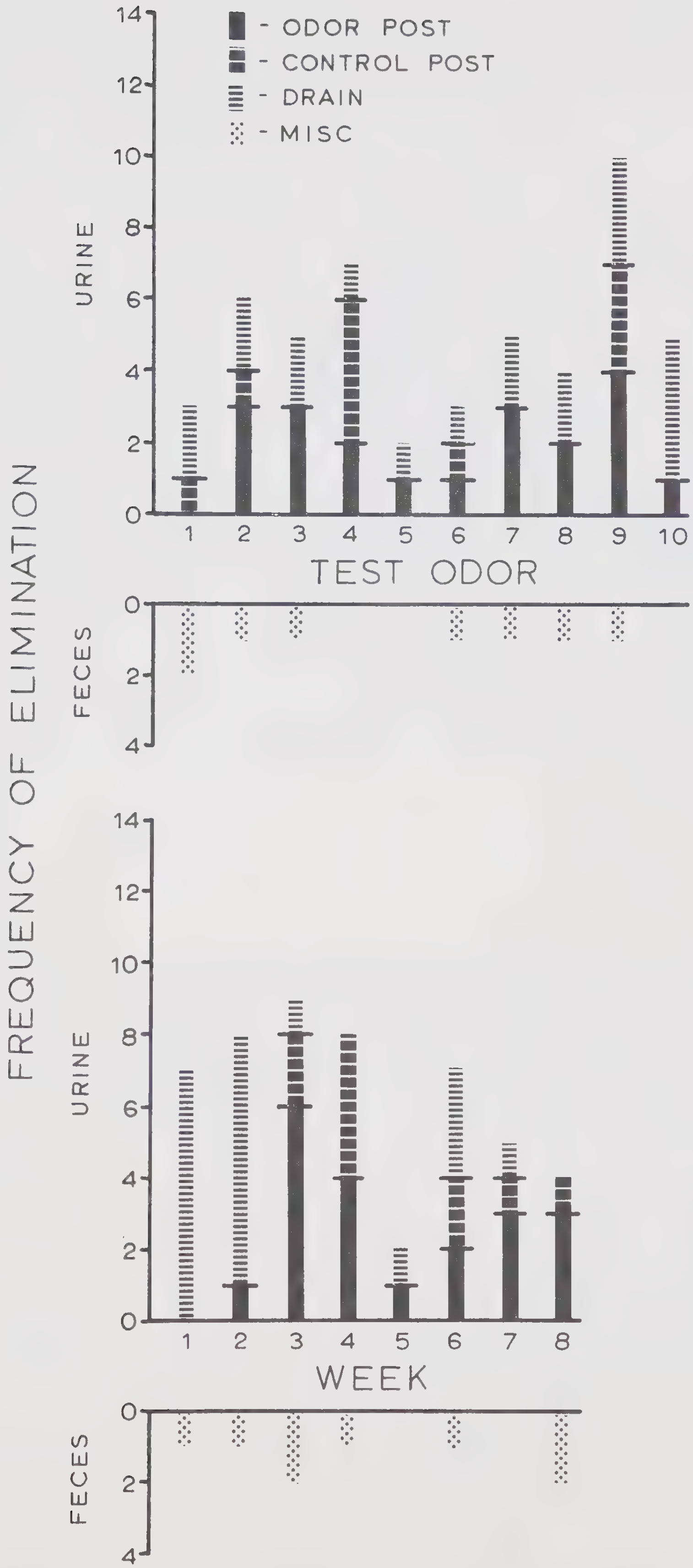


FREQUENCY OF ELIMINATION
ODOR POST
CONTROL POST
DRAIN
MISC
URINE
FECES
TEST ODOR
WEEK

Fig. 64. Relationship between the test odor and elimination by coyote J during the "Feces Experiment", over the period June 23 to August 19, 1970. The odors used were feces from:

1. Coyote K (G-AM1-3)
2. Coyote I (G-AM2-3)
3. Coyote J (G-AM3-3)
4. Coyote M (N-PM1-3)
5. Coyote O (N-PF2-3)
6. Coyote N (N-PF3-3)
7. Male domestic dog
8. Female domestic dog (anestrus)
9. Female domestic dog (estrus)
10. No odor

Fig. 65. Relationship between the week of the experiment and elimination by coyote J during the "Feces Experiment", over the period June 23 to August 19, 1970.

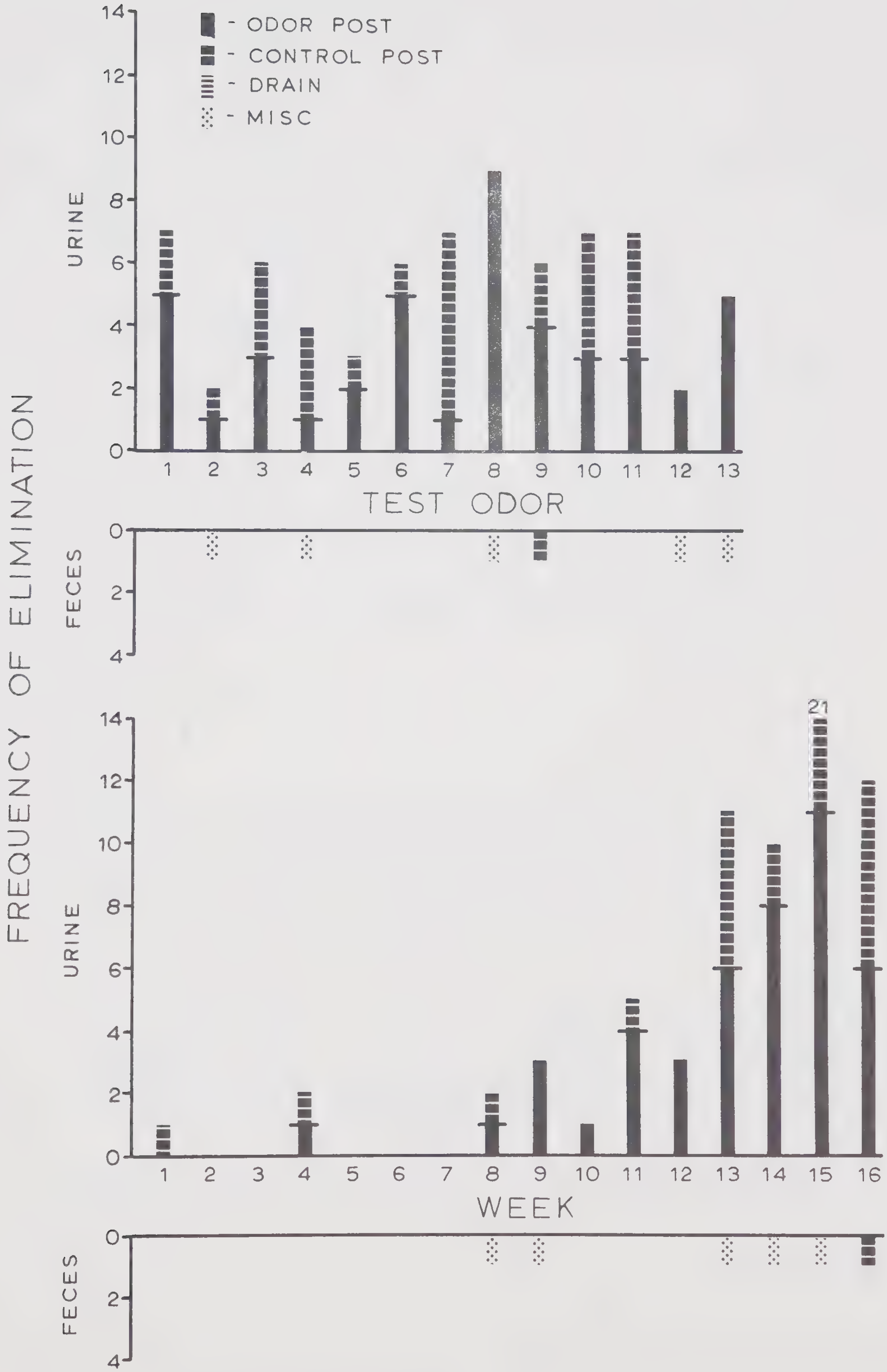


FREQUENCY OF ELIMINATION
ODOR POST
CONTROL POST
DRAIN
MISC
URINE
FECES
TEST ODOR
1
2
3
4
5
6
7
8
9
10
URINE
FECES
WEEK
1
2
3
4
5
6
7
8

Fig. 66. Relationship between the test odor and elimination by coyote K during the "K-I-J Experiment", over the period September 14, 1970 to February 23, 1971. The odors used were:

1. Urine - coyote K (G-AM1-3)
2. Feces - "
3. Urine - coyote I (G-AM2-3)
4. Feces - "
5. Urine - coyote J (G-AM3-3)
6. Feces - "
7. Urine - male domestic dog
8. Feces - "
9. Urine - female domestic dog (anestrus)
10. Feces - "
11. Urine - female domestic dog (estrus)
12. Feces - "
13. No odor

Fig. 67. Relationship between the week of the experiment and elimination by coyote K during the "K-I-J Experiment", over the period September 14, 1970 to February 23, 1971.



- ODOR POST
- CONTROL POST
- DRAIN
- MISC
FREQUENCY OF ELIMINATION
URINE
FECES
TEST ODOR
WEEK
21

Fig. 68. Relationship between the test odor and elimination by coyote I during the "K-I-J Experiment", over the period September 14, 1970 to February 23, 1971. The odors used were:

1. Urine - coyote K (G-AM1-3)
2. Feces - "
3. Urine - coyote I (G-AM2-3)
4. Feces - "
5. Urine - coyote J (G-AM3-3)
6. Feces - "
7. Urine - male domestic dog
8. Feces - "
9. Urine - female domestic dog (anestrus)
10. Feces - "
11. Urine - female domestic dog (estrus)
12. Feces - "
13. No odor

Fig. 69. Relationship between the week of the experiment and elimination by coyote I during the "K-I-J Experiment", over the period September 14, 1970 to February 23, 1971.

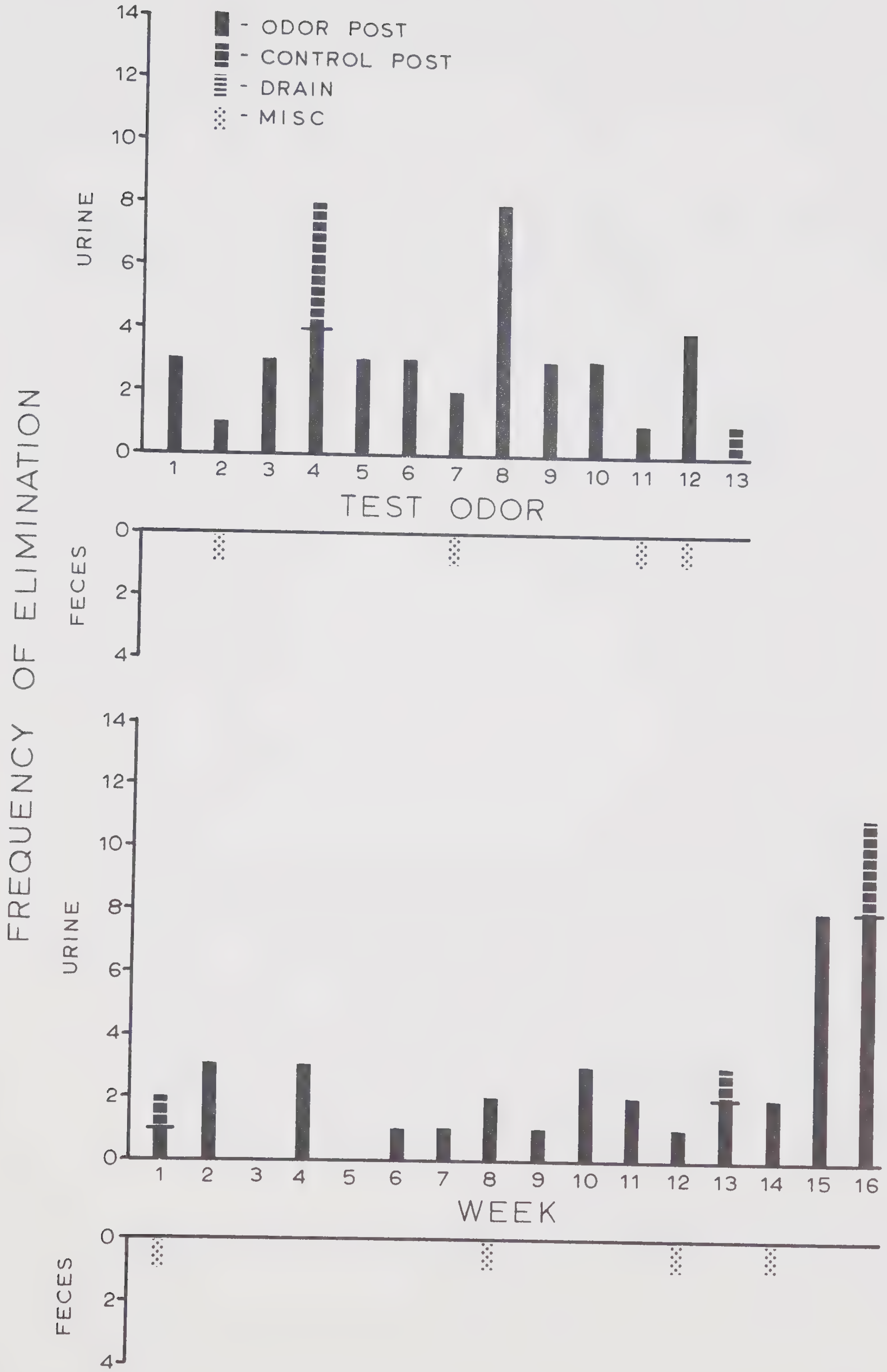
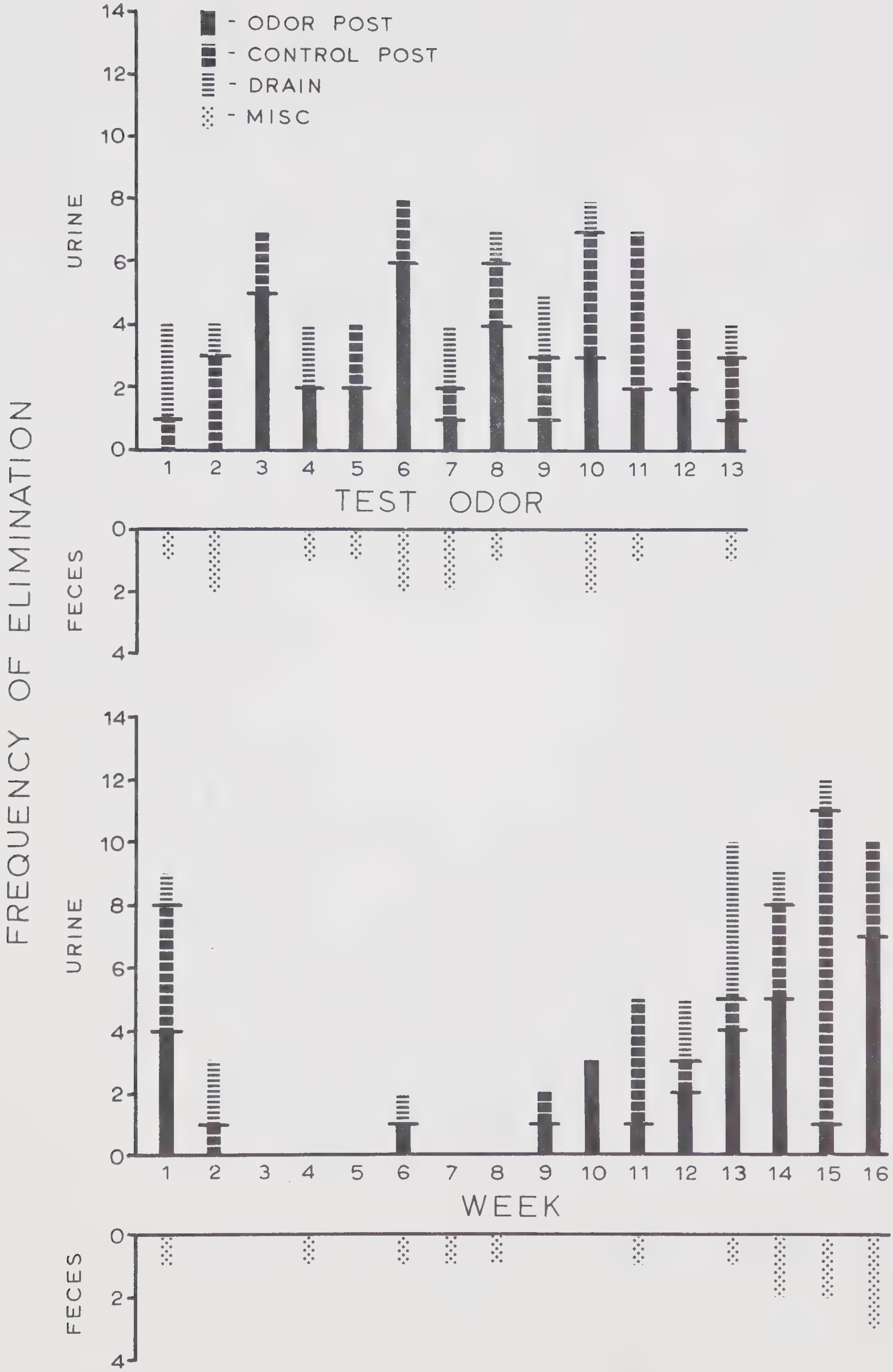

FREQUENCY OF ELIMINATION
- ODOR POST
- CONTROL POST
- DRAIN
- MISC
URINE
FECES
TEST ODOR
WEEK

Fig. 70. Relationship between the test odor and elimination by coyote J during the "K-I-J Experiment", over the period September 14, 1970 to February 23, 1971. The odors used were:

1. Urine - coyote K (G-AM1-3)
2. Feces - "
3. Urine - coyote I (G-AM2-3)
4. Feces - "
5. Urine - coyote J (G-AM3-3)
6. Feces - "
7. Urine - male domestic dog
8. Feces - "
9. Urine - female domestic dog (anestrus)
10. Feces - "
11. Urine - female domestic dog (estrus)
12. Feces - "
13. No odor

Fig. 71. Relationship between the week of the experiment and elimination by coyote J during the "K-I-J Experiment", over the period September 14, 1970 to February 23, 1971.



ODOR POST
CONTROL POST
DRAIN
MISC
FREQUENCY OF ELIMINATION
URINE
FECES
TEST ODOR
WEEK
0
2
4
6
8
10
12
14
1 2 3 4 5 6 7 8 9 10 11 12 13
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

Fig. 72. Relationship between the test odor and elimination by coyote K during the "K-I-O-S Experiment", over the period March 30 to July 22, 1971. The odors used were:

1. Urine - coyote M (N-JM1-4)
2. Feces - "
3. Urine - coyote P (N-JM2-4)
4. Feces - "
5. Urine - coyote Q (N-AF3-4)
6. Feces - "
7. Urine - coyote N (N-AF4-4)
8. Feces - "
9. No odor

Fig. 73. Relationship between the week of the experiment and elimination by coyote K during the "K-I-O-S Experiment", over the period March 30 to July 22, 1971.

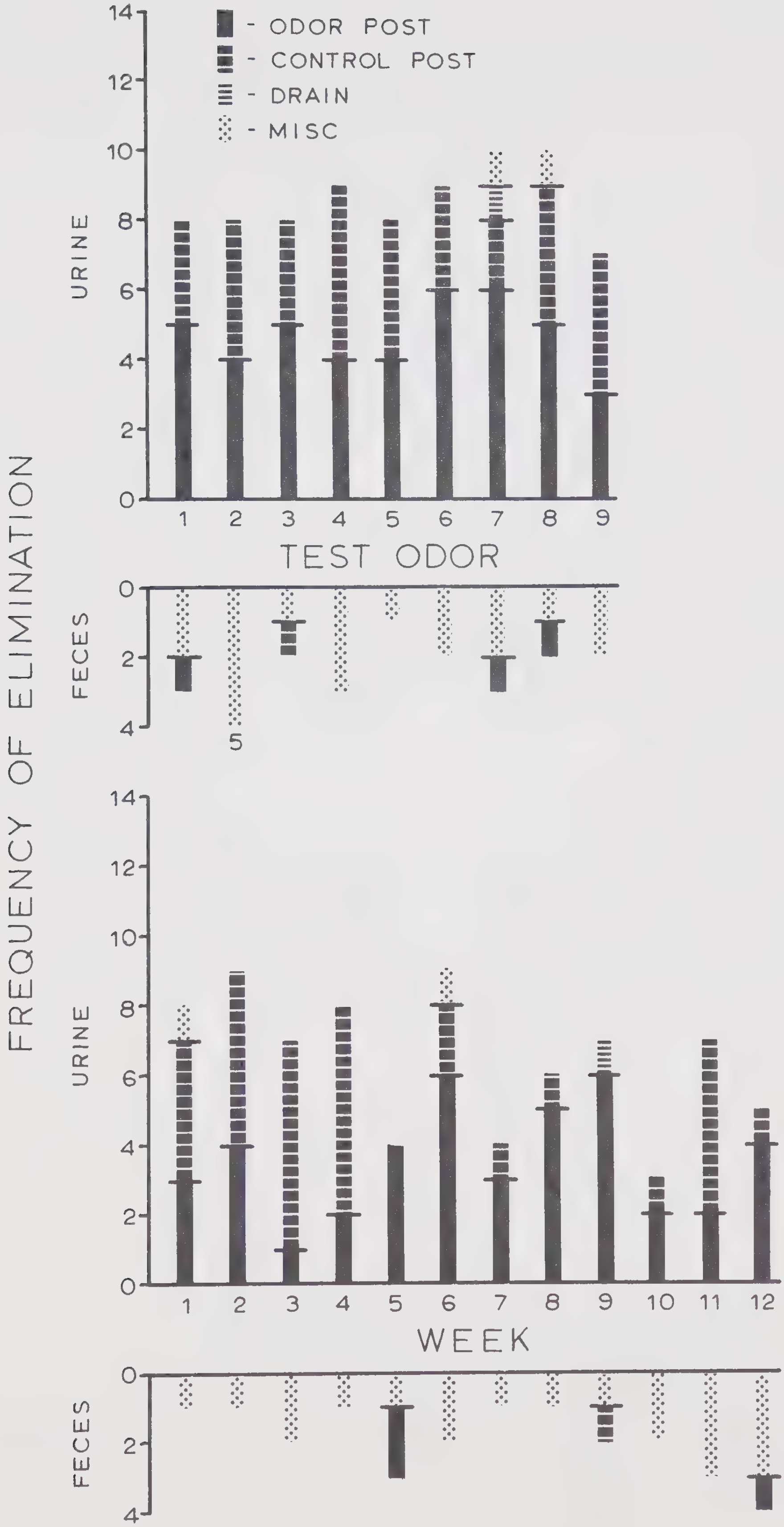
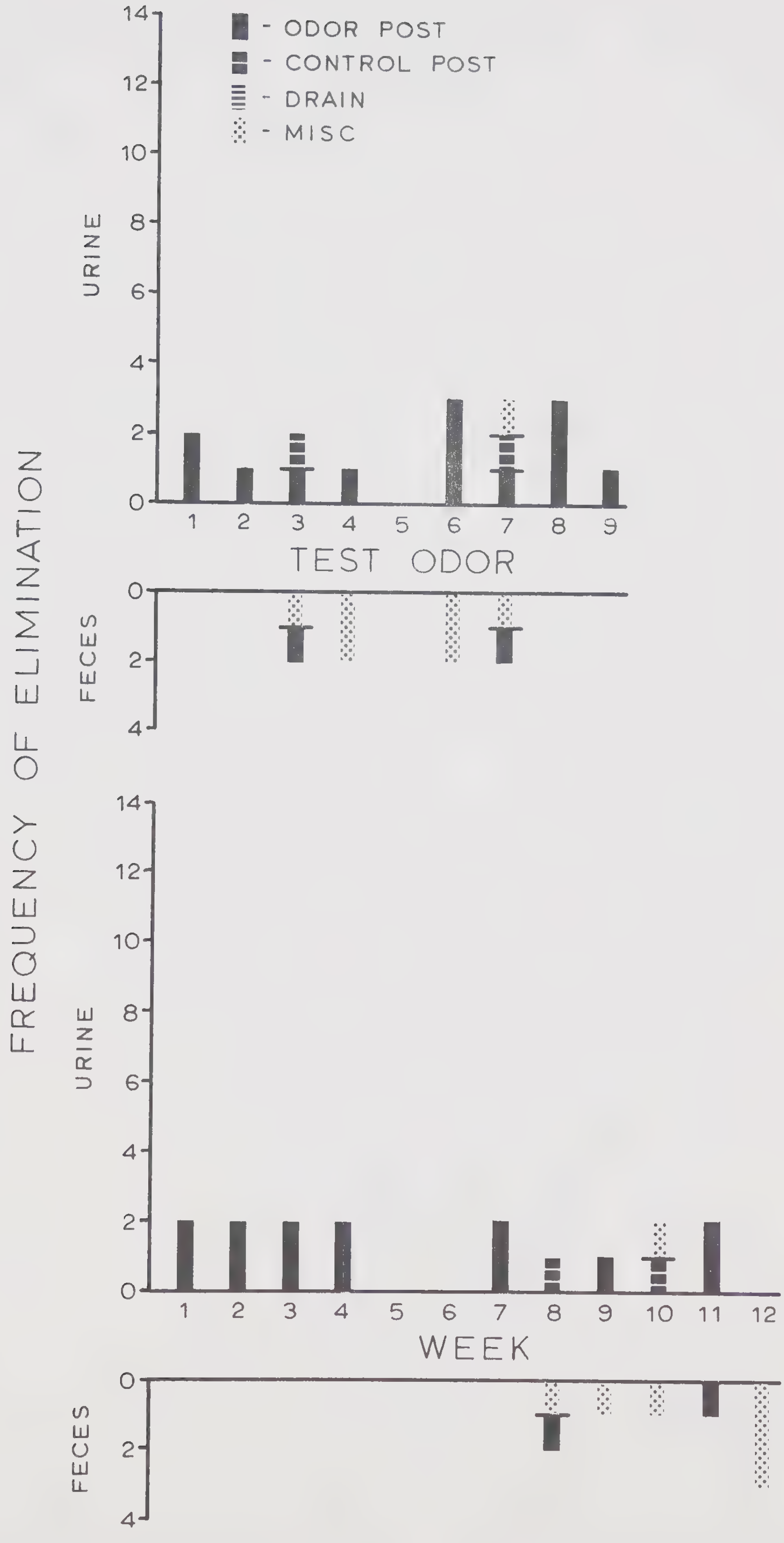

FREQUENCY OF ELIMINATION
ODOR POST
CONTROL POST
DRAIN
MISC
URINE
FECES
TEST ODOR
WEEK
0
2
4
6
8
10
12
14
1 2 3 4 5 6 7 8 9
5
1 2 3 4 5 6 7 8 9 10 11 12

Fig. 74. Relationship between the test odor and elimination by coyote I during the "K-I-O-S Experiment", over the period March 30 to July 22, 1971. The odors used were:

1. Urine - coyote M (N-JM1-4)
2. Feces - "
3. Urine - coyote P (N-JM2-4)
4. Feces - "
5. Urine - coyote Q (N-AF3-4)
6. Feces - "
7. Urine - coyote N (N-AF4-4)
8. Feces - "
9. No odor

Fig. 75. Relationship between the week of the experiment and elimination by coyote I during the "K-I-O-S Experiment", over the period March 30 to July 22, 1971.



ODOR POST
CONTROL POST
DRAIN
MISC
FREQUENCY OF ELIMINATION
URINE
FECES
TEST ODOR
WEEK

Fig. 76. Relationship between the test odor and the week of the experiment, in relation to the total time that coyotes M, O, N, P, Q, and S spent at the odor post during the "M-O-N and P-Q-S Experiments" (combined), over the period September 15, 1970 to February 3, 1971. The odors used were:

1. Urine - coyote M (JM1-3)
2. Feces - "
3. Urine - coyote O (JF2-3)
4. Feces - "
5. Urine - coyote N (JF3-3)
6. Feces - "
7. Urine - coyote P (JM1-3)
8. Feces - "
9. Urine - coyote Q (JF2-3)
10. Feces - "
11. Urine - coyote S (JF3-3)
12. Feces - "
13. No odor

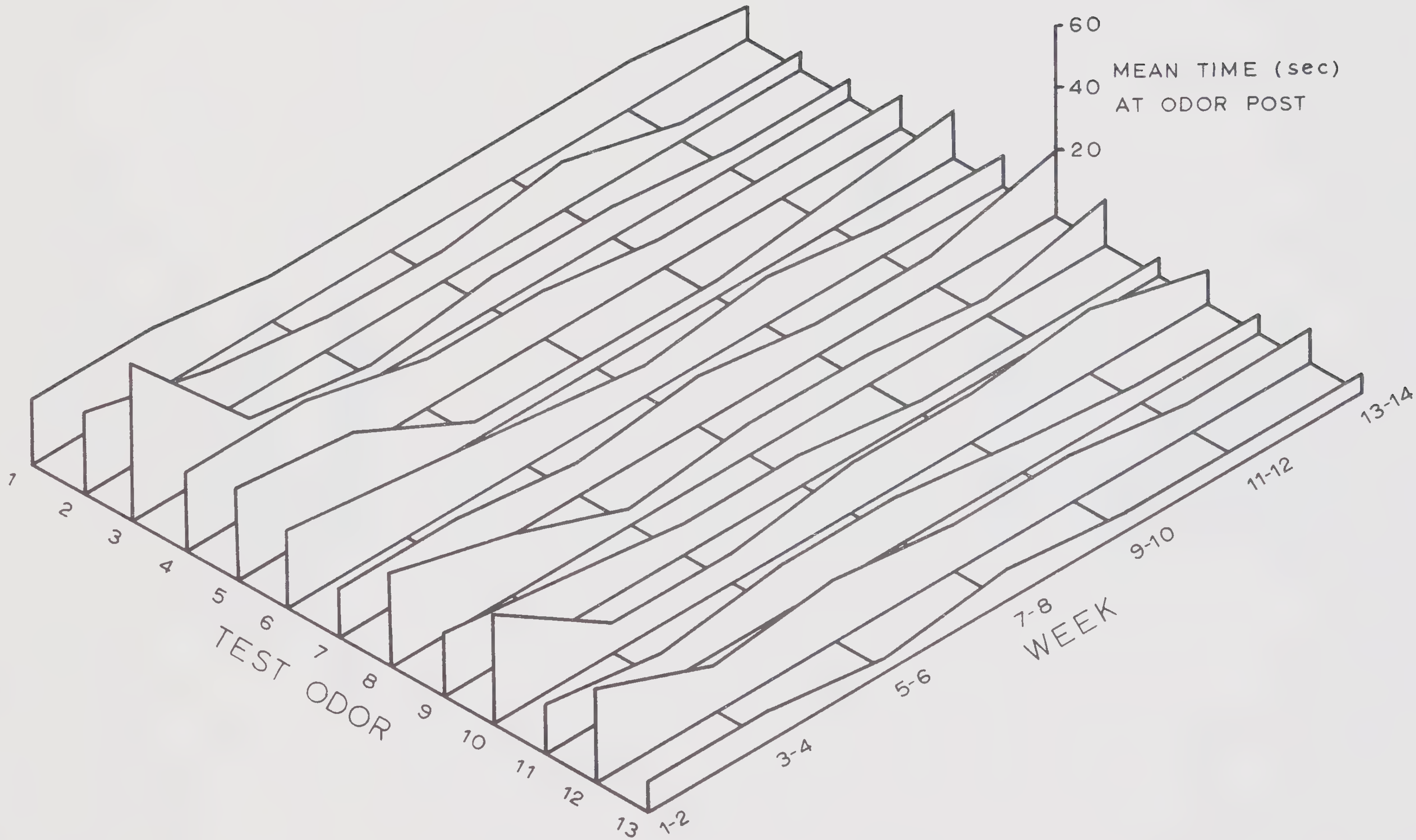

60
40
20
MEAN TIME (sec)
AT ODOR POST
1
2
3
4
5
6
7
8
9
10
11
12
13
TEST ODOR
1-2
3-4
5-6
7-8
9-10
11-12
13-14
WEEK

Fig. 77. Mean frequency of urinations per experiment exhibited by coyotes K, I, and J (adult males), over the period June 22, 1970 to July 22, 1971. The mean values were calculated from the total number of urinations that coyotes K, I, and J displayed during all of the tests that used them.

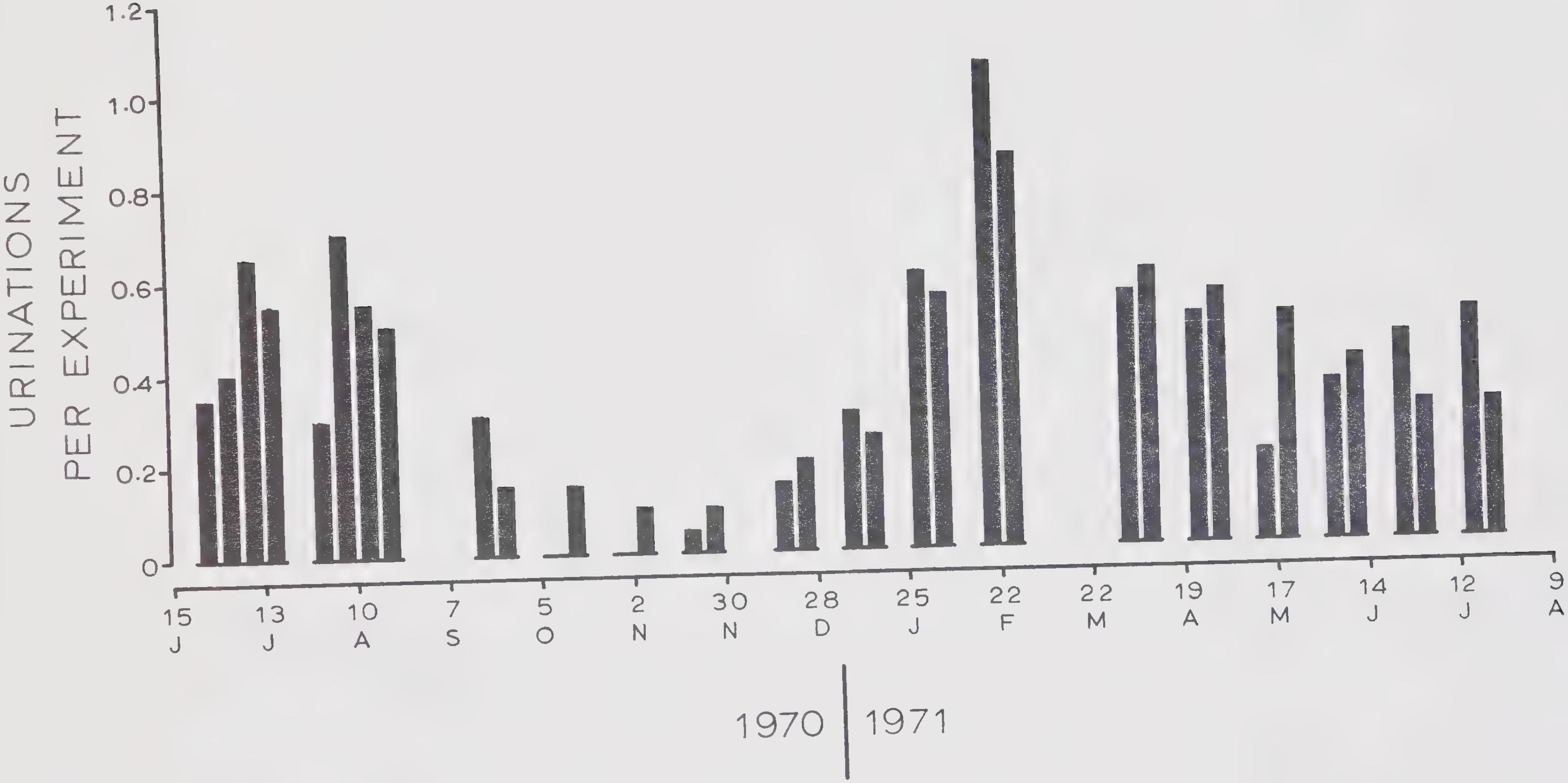
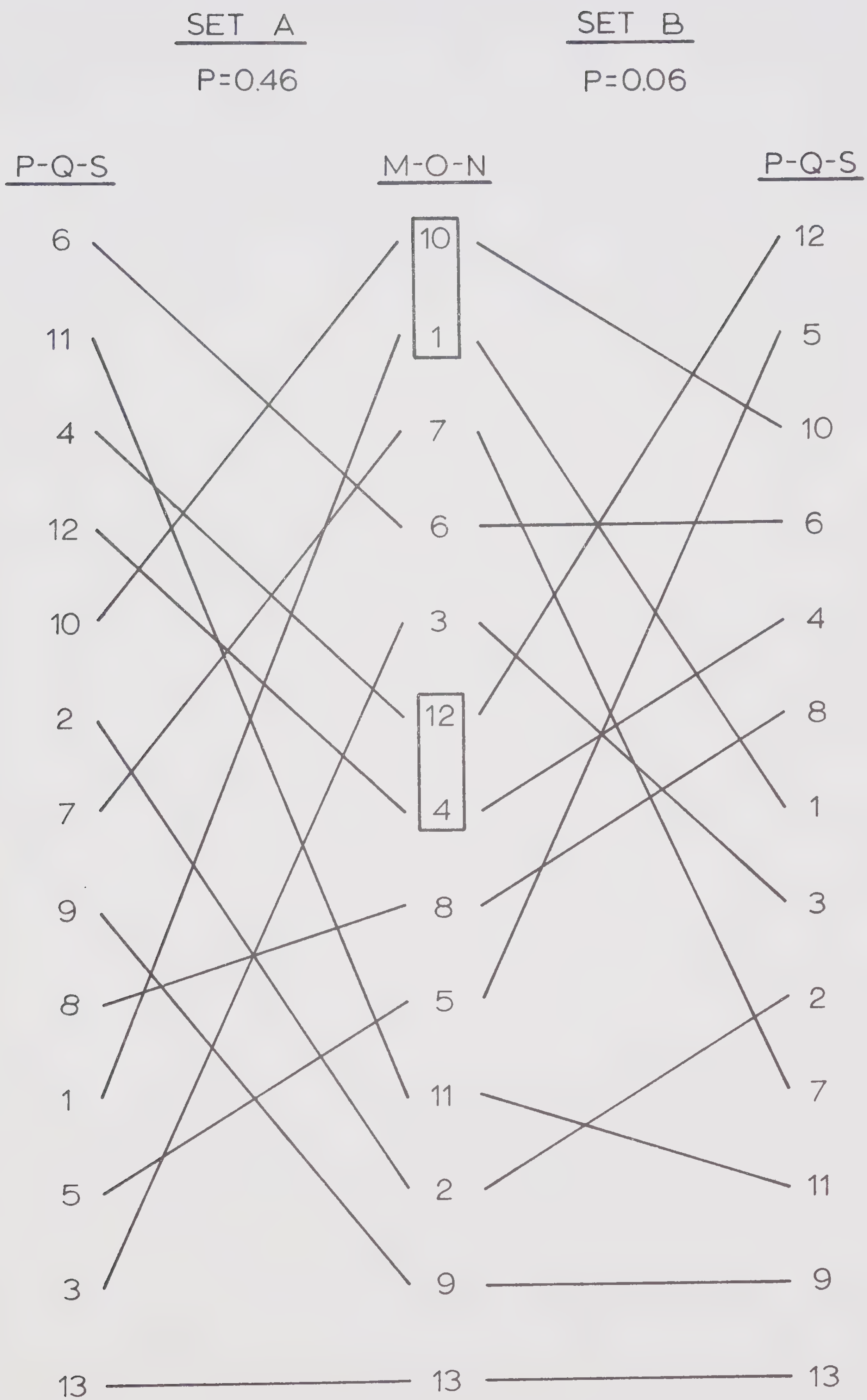

URINATIONS
PER EXPERIMENT
1.2
1.0
0.8
0.6
0.4
0.2
0
15 J
13 J
10 A
7 S
5 O
2 N
30 N
28 D
25 J
22 F
22 M
19 A
17 M
14 J
12 J
9 A
1970
1971

Fig. 78. A comparison of the total time spent at the test odors between the "M-O-N and P-Q-S Experiments". Set A compares the responses on a group odor versus non-group odor basis. Set B compares the responses on an animal-odor basis. The probability values of a relationship within each set were computed using Kendall's coefficient of rank correlation. The "blocked" numbers represent ties. Lines from ties values are drawn in such a way that they do not intersect.

	Set A	Set B
Group	1. Urine - dominant male	1. Urine - coyote M
	2. Feces - " "	2. Feces - "
	3. Urine - beta female	3. Urine - coyote O
	4. Feces - "	4. Feces - "
	5. Urine - subordinate female	5. Urine - coyote N
	6. Feces - "	6. Feces - "
Non-group	7. Urine - dominate male	7. Urine - coyote P
	8. Feces - "	8. Feces - "
	9. Urine - beta female	9. Urine - coyote Q
	10. Feces - "	10. Feces - "
	11. Urine - subordinate female	11. Urine - coyote S
	12. Feces - "	12. Feces - "
	13. No odor	13. No odor


SET A
P=0.46
SET B
P=0.06
P-Q-S
M-O-N
P-Q-S
6 11 4 12 10 2 7 9 8 1 5 3 13
10 1 7 6 3 12 4 8 5 11 2 9 13
12 5 10 6 4 8 1 3 2 7 11 9 13